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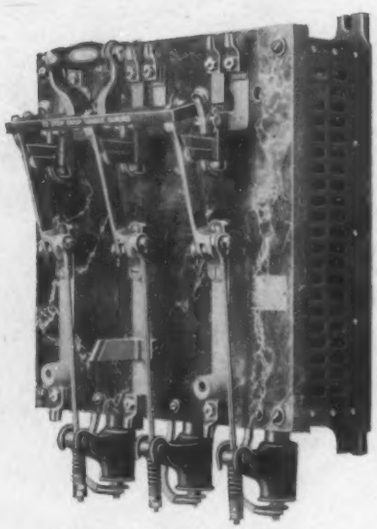

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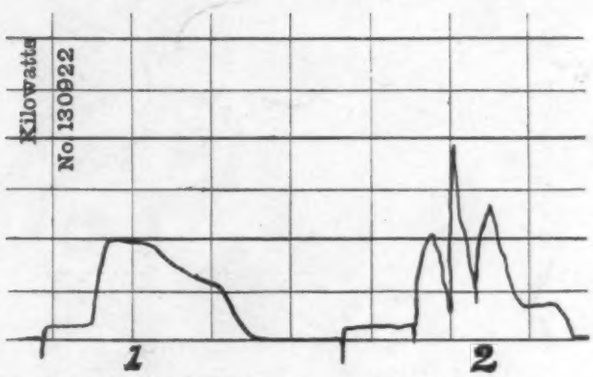

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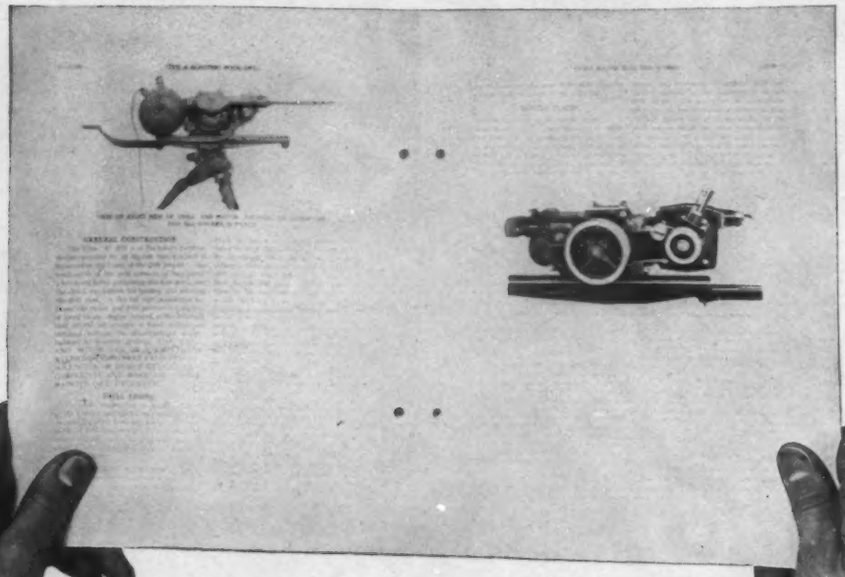

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VOLUME XXVI SAN FRANCISCO, MARCH 18, 1911 NUMBER 11

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A HEAVY BLAST IN DAM CONSTRUCTION

An interesting example of the use of heavy blasts in the construction of a high, rock-fill, storage reservoir dam is exemplified in the Cucharas Dam, Huerfano County, Colorado. This dam is being built by the Pueblo-Rocky Ford Irrigation Company. It will be of the rock-fill type with a concrete face and spillway. It will have an elevation to the spillway crest of 125 ft. and a length of 534.3 ft. There will be required in its construction approximately 210,000 cu. yds. of broken rock and 6000 cu. yds. of concrete.

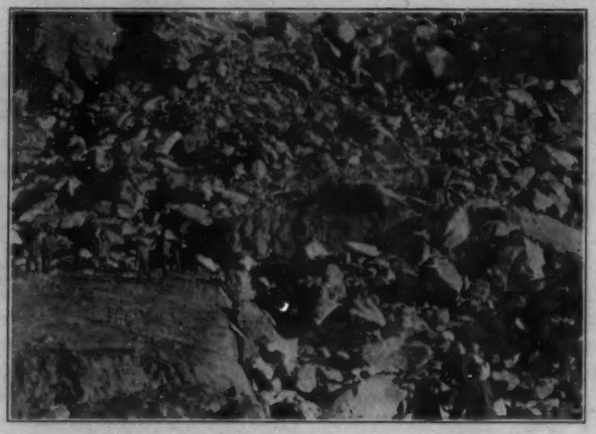
Site of the Cucharas Dam of the Pueblo Rocky Ford Irrigation Company.

The site of the dam is a box canyon, between walls of limestone, sandstone and shale, the strata being more or less horizontal. In anticipation of floods, which might be encountered before completion of the embankment to the spillway line, construction is designed with a view of passing the flood-water over the embankment. For this reason, rocks of the largest possible size are required, especially for construction of the down stream toe and for surfacing the downstream slope.

In order to obtain rock of the desired character, it was proposed to place a heavy blast in the wall of the canyon adjacent to the downstream toe of the dam and bring down a large quantity of rock to the base of the dam.

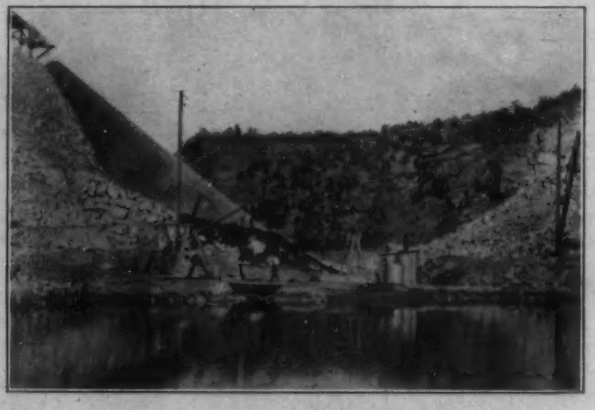
A "coyote-hole," or "one-man" tunnel was driven into the east wall of the canyon and above a bedrock trench along the downstream toe of the embank-

Site Showing Coyote Hole in Which Charge Was Placed.



Result of the Break.

Firing the Charge.



Site Ten Weeks Later.

ment. The "coyote-hole" is shown at the top of the left-hand dump; it was driven a distance of 40 ft. into the cliff, at which point a cross-cut or "T" was excavated, a distance of 24 ft. between headings. At each heading of the cross-cut a shaft 4 ft. x 4 ft. x 4 ft. was sunk below the tunnel floor.

Each of the pits was charged with 7500 lb. of F. F. B. powder and 500 lb. of 40 per cent dynamite, connected with electric fuses and leading wire which was carried to a firing battery located about 300 ft. distant. The cross-cuts and tunnel were then back-filled with earth, which was thoroughly tamped.

Firing of the charge is shown in the second view of the group and in it may be plainly seen the path of rocks. Some of these rocks weighed from 2000 to 3000 lb. and were sent, at high velocity, across the canyon, a distance of 250 ft.

A view of the break and an idea of the size of rocks placed in the downstream toe-trench is next in order.

Some idea of the amount of work which was done on this dam in ten weeks is given in the last picture; as it was taken about that length of time after the general view first shown.

The cost of driving the tunnel, of explosives and of setting and firing the charge, was as follows:

Labor	$ 384.00
Powder	1140.00
Dynamite	155.00
Caps and fuse	10.50
	$1689.50

The cost of breaking 10,000 cu. yds. of rock was therefore 16-89/100 cents per cu. yd.

This work is being done under contract by the Phillips Construction Company & O'Gara of Denver, Wm. M. Strong being engineer in charge.

GOVERNMENT SUIT AGAINST LAMP MANUFACTURERS.

The Attorney General of the United States on March 3rd instituted suit against 35 incandescent lamp companies, including the members of the National Electric Lamp Association, the General Electric Co., and the Westinghouse Lamp Co., on the charge of engaging in unlawful contracts, combinations and conspiracies in restraint of interstate commerce. On the basis of patents owned by these companies it is stated that they have monopolized the manufacture of incandescent lamps and suppressed competition. It is believed that the combination will be voluntarily dissolved without litigation.

PACIFIC COAST PRACTICE AS REGARDS THE USE OF CRUDE PETROLEUM AS FUEL.

The December, 1910, meeting of the American Society of Mechanical Engineers was devoted to a discussion of Pacific Coast practice as regards the use of crude petroleum as fuel. The papers presented are published in full in the following pages:

PRESENT AND FUTURE SUPPLY OF PETROLEUM AS FUEL ON THE PACIFIC COAST.

BY ARTHUR F. L. BELL.

In the study of our petroleum deposits we have to deal with the leading mineral industry of California. Its exploitation commencing in the early sixties, with a recorded production in 1875 of only 3000 barrels, has been increased to 75,000,000 barrels for the year 1910. Attention was first drawn to the presence of petroleum in California by the discovery of numerous oil seepages in Los Angeles, Ventura, Santa Barbara and adjacent counties. A large portion of these counties are mountainous, the formation is broken and tilted, with a result that oil in many places can be seen seeping from the rocks. Even in the Pacific Ocean, from Port Harford to San Pedro, there are numerous oil springs where petroleum rises to the surface and spreads out, giving the ocean a glazed surface many miles in area.

The first oil producers in California knew practically nothing of the geology of the oil or of the districts where they operated. They looked for a location where oil bearing rocks were exposed with oil seeping from them. They then determined, to the best of their judgment, the angle or dip of the strata and located their wells so as to reach the oil at a shallow depth. Many of the wells were failures, partly due to misjudgment of the depth of the strata, or, to the formation having been already drained of its oils. The uncertainty and expense of drilling deeper wells often prevented an extension of proven territory. As late as 1900 a well 2000 feet in depth was considered exceptionally deep and there were but a few in the State, whereas, today, we have wells of a mile or over in depth.

Most of the early drilling was confined to Ventura county and until the discovery of the Los Angeles City field, no other area exceeded 40 acres. In 1892 the Los Angeles field came in with an approximate area of 4000 acres. The oil territory traversed a narnow strip in the northwestern portion of the city, crossing hundreds of city lots, with the result that all lot owners became oil operators, or leased their lots to others. The formation was so easily drilled that portable rigs were used and, in many instances, 8000 foot wells were completed in a week. Such conditions resulted in an immediate over-production with a corresponding drop in price, from about $1.50 per barrel, previous to the discovery of the Los Angeles field, to from 15 to 30 cents per barrel in Los Angeles in 1896. This low price resulted in the adoption of oil by every Southern California industry that required fuel. The real opening of California's oil industry may be said to have dated from the discovery of the Los Angeles field. In 1898 this field was on the wane and the price of oil rose to one dollar. The development of this field and the universal adoption of oil in Southern California had educated and interested so many men in the oil industry, that as it showed signs of exhaustion, they branched out, seeking new fields, with the result that the Fullerton, Coalinga, Kern River, McKittrick and Sunset fields were immediately exploited, in the order named. By 1902 so much oil had been developed that the price again fell to 15 or 20 cents per barrel in the Kern field. The production of the cheap Kern River oil forced its use over the Pacific Coast States as well as the Hawaiian Islands.

In giving a brief history of the development of the oil industry, it is my endeavor to show that in the first stages of the business, the discovery and development of oil was largely a matter of chance. All of the early fields were discovered by drilling close to oil seepages, including the Los Angeles city field, Kern River, Coalinga and Sunset. The Summerland field was discovered by chance through digging a water well. The Kern River was discovered by a wood chopper who, having seen a small seepage on the bank of Kern River, dug a well and with the proverbial good luck of the novice, struck oil at about 75 feet. Today the industry has become so well understood that, to extend the field, instead of the operator hugging the outcrop, he confidently locates his well far out into the valley, or in the outlying ranges within the possible oil belt, in many cases miles from the nearest production. Where he has used fair judgment based on the knowledge which we now have of the geological conditions of the oil measures, the chance of failure has been greatly reduced, as is shown by the recent and important discoveries of oil and gas in the Lost Hills, Kettleman Hills, Buena Vista Hills and Elk Hills, in Kings and Kern Counties. These discoveries made during the last year have proved the existence of oil over large areas where heretofore it was a matter of conjecture.

The present development of the oil industry is due, first, to the great improvements which have been made during the last ten years in the art of drilling wells, which has enabled us to reach successfully and economically depths of from 4000 to 5000 feet, and second, to the knowledge we have acquired of the oil bearing formation. For the latter, we are to a great extent indebted to the splendid work of the United States Geological Survey, which has for the last few years had a corps of geologists in the field, mapping and cross-sectioning proven and possible oil territory. This has resulted in our being able to trace the oil bearing strata under large areas of yet unproven territory; and it is satisfactory to note that during the last year, successful discoveries have been made in far outlying districts which have been reported as possible oil territory by the Survey.

The California oil fields are found in rocks of the tertiary, whereas the Eastern fields, with one or two exceptions, are found in earlier geological formations. California oils are found mostly in loose sandy beds; in many cases these sand strata are from 400 to 500 feet thick, which allow enormous storage of oil. In Eastern fields the older rocks have become so cemented and are so close grained that there is no room for storing oil, this accounts for the small production per acre of Eastern wells compared with those of California.

In 1908, the United States Geological Survey reported 8450 square miles of possible oil territory in the United States, giving California 850 square miles or about one-tenth of the total area; but they give her credit for one-half of the probable minimum oil production of the United States, or one-third of the probable maximum production.

The United States Geological Survey has estimated the contents of the probable oil lands of the United States in barrels of 42 gallons as follows:

	Minimum.	Maximum.
Appalachian field	2,000,000,000	5,000,000,000
Lima-Indiana field	1,000,000,000	2,000,000,000
Illinois field	350,000,000	1,000,000,000
Mid-continent field	400,000,000	1,000,000,000
Gulf field	250,000,000	1,000,000,000
California field	5,000,000,000	8,500,000,000
Minor fields	1,000,000,000	5,000,000,000
Total	10,000,000,000	24,500,000,000

California's greater productiveness is due to the greater thickness of loose oil sands. The 1907 Survey report of average daily production of wells in the different fields of the United States shows that California wells pump three times as much as those in the Gulf fields and five to eight times as much as the other active Eastern fields.

Appalachian field	1.73 barrels
Lima-Indiana field	2.74 barrels
Colorado and Wyoming field	3.35 barrels
Illinois field	3.37 barrels
Mid-continent field	5.29 barrels
Gulf field	14.08 barrels
California field	42.56 barrels

The estimated production given by the United States Geological Survey were conservative estimates when made two years ago. Development in the industry has however been so rapid, that the estimates of proven and possible territory made then, will not answer for today. I have therefore compiled an estimate of what I consider the proven and prospective areas in California today, which shows a total area of practically proven oil territory of 94,200 acres, with an estimated production of 4,319,000,000 barrels and a probable extension of oil territory of 338,320 acres with an estimated production of 13,258,000,000 barrels, making a grand total of proven and probable territory of 432,520 acres and 17,577,000,000 barrels. The total consumption to date has been about 383,000,000 barrels, leaving an estimated future possible production of 17,194,000,000 barrels.

The accompaning table gives an itemized statement of production by districts and counties:

In submitting the above estimate of extractable oil, which is about double the United States Geological Survey estimate, I can only say that it is impossible for any one to state definitely what our actual production will be. I have included as possible territory only what I consider probable territory, amounting to about 700 square miles; but it is quite possible that a greater acreage will be developed which will bring the total up to or over the estimate of the United States Geological Survey of 850 square miles. This should again increase the quantity of prospective extractable oil.

In my computation I have assumed the interstices in the sand to be 3/10 of its bulk, and that it is filled with oil of which 1/10 would be held by capillary attraction to the sand, 1/10 as readily extractable oil and the remaining 1/10 as oil which cannot be obtained. This would admit a production of about ¾ gal. per cubic foot. To substantiate these figures, I will state that prior to 1900, the Alcatraz Asphalt Co.,

CALIFORNIA'S ESTIMATED FUTURE OIL SUPPLY.

County and District	Proven Acreage	Thickness of sand (feet)	Estimated Production (barrels)	Possible Acreage	Thickness of sand (feet)	Estimated Production (barrels)	District Grand Total Acreage	District Grand Total Production (barrels)	County Grand Total Acreage	County Grand Total Production (barrels)
Fresno—										
Coalinga	29,000	50	1,128,000,000	21,440	50	834,000,000	50,440	1,962,000,000		
Kettleman Hills				20,080	50	778,000,000	20,080	778,000,000		
Krevenhagen Hills										
County total	29,000		1,128,000,000	41,520		1,612,000,000			70,520	2,740,000,000
Kings—										
Kettleman Hills				53,120	50	2,064,000,000	53,120	2,064,000,000		
County total				53,120		2,064,000,000			53,120	2,064,000,000
Kern—										
Lost Hills				46,080	50	1,800,000,000	46,080	1,800,000,000		
Devil's Den				14,720	50	596,000,000	14,720	596,000,000		
Antelope Hills				16,000	50	622,000,000	16,000	622,000,000		
McKittrick	2,000	50	85,000,000	6,400	50	250,000,000	8,800	380,000,000		
	400	150	45,000,000							
Midway-Sunset	40,000	50	1,700,000,000	100,480	50	4,000,000,000	140,480	5,700,000,000		
San Emidio				12,000	50	466,000,000	12,000	466,000,000		
Kern River	6,000	150	590,000,000				6,000	590,000,000		
County total	48,400		2,420,000,000	195,680		7,734,000,000			244,080	10,154,000,000
Santa Barbara—										
Santa Maria	3,600	25	70,000,000				3,600	70,000,000		
Lompoc	1,280	25	25,000,000	2,000	50	26,000,000	3,280	51,000,000		
Cat Canyon	1,920	50	76,000,000	16,000	50	622,000,000	17,920	698,000,000		
County total	6,800		171,000,000	18,000		648,000,000			24,800	819,000,000
Southern California fields—										
Fullerton	5,000	100	400,000,000	5,000	50	200,000,000	10,000	600,000,000		
Whittier										
Olinda, etc.										
Miscellaneous	5,000	50	200,000,000	25,000	50	1,000,000,000	30,000	1,200,000,000		
Southern Cal. total	10,000		600,000,000	30,000		1,200,000,000			40,000	1,800,000,000
Total: Proven acreage	94,200									
Total: Possible acreage				338,320						
Estd production: Proven acreage			4,319,000,000							
Estd production: Possible acreage						13,258,000,000				
Final grand totals							432,520	17,577,000,000	432,520	17,577,000,000
Less oil produced to 1911								383,000,000		383,000,000
California's estimated future supply								17,194,000,000		17,194,000,000

in Santa Barbara County, of which I was manager, mechanically extracted from the bituminous sands at its Carpenteria and Sisquoc refineries, 27 per cent and 25 per cent respectively, of bitumen. These were exposed oil sands from which the bitumen or dried out oil was being extracted.

In 1901 Bernard Bienenfeld, William Mulholland, and the writer, as commissioners for the purpose of appraising the value of the different properties in the Kern field that were to form the Associated Oil Company, determined that the Kern field oil sand did contain 32 per cent of void in the sand and when filled with oil, amounted to 2.4 gallons per cubic foot.

It will therefore be seen that an estimate based on an extraction of ¾ gallons per cubic foot, or 750 barrels per acre foot, should not be considered as unreasonable if the correct thickness of producing sands is figured. I quote from a paper on the oil industry read before the mining students of the University of California by Mr. M. L. Requa: "A few of the practical results from California fields that are obtainable at this date as follows:

Sauer Dough in Coalinga: Claimed thickness of sand 60 ft. Production per acre 96,000 barrels, or about 1600 barrels per acre foot.

Claremont in Kern River: Claimed thickness of sand 250 feet. Production per acre 93,000 barrels or about 330 barrels per acre foot.

Peerless in Kern River: Claimed thickness of sand 300 feet. Production per acre 84,000 barrels or about 280 barrels per acre foot.

Santa Fe in Fullerton: Thickness of sand over 700 feet. Production per acre 93,000 barrels or about 132 barrels per acre foot.

Los Angeles: Thickness of sand 100 feet. Production 75,000 barrels per acre or about 750 barrels per acre foot.

It is worthy of note that all of these properties are still active producers.

The following is a list of the recorded production of California from 1875 to 1910, inclusive, and the average daily production per well:

	Total barrels produced.	Average bbl. per well per day.
1875	3,000	4.11
1876	12,000	16.39
1877	13,000	11.87
1878	15,227	13.91
1879	19,858	13.75
1880	40,552	15.83
1881	99,862	27.35
1882	128,636	27.11
1883	142,857	24.46
1884	262,000	35.74
1885	325,000	38.70
1886	377,145	39.74
1887	678,572	50.24
1888	690,333	39.30
1889	303,220	16.28
1890	307,360	15.88
1891	323,600	11,98
1892	385,049	9.50
1893	470,179	8.26
1894	705,969	10.12
1895	1,208,482	13.19
1896	1,252,777	8.78
1897	1,903,411	9.57
1898	2,257,207	8.30
1899	2,642,095	7.66
1900	4,324,484	9.15
1901	8,786,330	11.19
1902	13,984,268	15.99
1903	24,382,472	25.94
1904	29,649,434	29.84
1905	33,427,473	33.49
1906	33,098,598	34.07
1907	39,748,375	42.56
1908	48,306,910	41.00
1909	57,545,477	43.10
1910 (estimated)	75,000,000	42.10
Total	382,821,212	

To determine the life of our field, taking the submitted figures as a basis, we would have if we assumed the present production of 75,000,000 barrels as the maximum consumption, 52½ years supply for the proven territory and for the proven and prospective territory, less consumption to date, about 230 years supply. If our consumption is increased, as it naturally will be, the life of our fields must be reduced proportionally.

Our consumption for 1910 will amount to about 63,000,000 barrels, as about 12,000,000 barrels will have gone into storage this year. At the end of 1910, we will have in storage about 30,000,000 barrels or about five months' supply.

RELATIVE VALUE OF LIGHT OIL AS COMPARED WITH HEAVY OIL.

BY J. N. LE CONTE.

The object of the following note is to show the approximate relation that holds between the heating value and specific gravity of California crude petroleum.

Crude petroleum consists principally of various combinations of hydrogen and carbon together with comparatively small amounts of nitrogen, oyxgen and sulphur. The nitrogen and oxygen and any incombustible residue or ash may be classed as inert impurities. The sulphur, though combustible, has a low grade of heating value and is otherwise injurious.

Taking hydrogen and carbon as the principal constituents, it is found that those oils which are rich in the former element are of light specific gravity as compared with those rich in carbon. The range in specific gravity of California oils may be taken as from unity to 0.84, or from 10 to 36 of the Baume scale. The majority of the fuel oils will range from unity to 0.9, or from 10 to 23 Baume.

In regard to the heating value, it is also evident that, other things being equal, those oils rich in hydrogen will contain more heat units per pound than those rich in carbon. Pure hydrogen contains 62,000 B.t.u. per pound, as compared with 14,500 B.t.u. per pound for carbon. If the substance in question, therefore, were composed wholly of these two elements, a consistent law might be expressed between the heat units per pound, and the specific gravity. As a matter of fact the other substances occurring in varying amounts destroy any exact relation.

Water in emulsion in crude oil, not only acts as an inert impurity in a sample under test, but must be converted into steam in the furnace and this still further reduces the heat value of the fuel per pound. It occurs in such variable, and often in such large amounts, that no relation whatever between specific gravity and B.t.u. per pound can be discerned unless its presence is eliminated. In the following tables and diagrams, therefore, the oil is anhydrous, the water having either been removed before testing, or else its amount has been determined and corrected for.

Nitrogen and oxygen are also inert impurities, but since their amounts are small, their effects are averaged in the plotted results.

Sulphur is a substance which causes considerable variation in the heating value of fuel oil. Sulphur contains 3900 B.t.u. per pound. Oils rich in sulphur,

therefore, have a lower heating value per pound, other things being equal.

Many determinations of heating values and specific gravities of California oils have been made, but those upon which the following table is based have been furnished through the kindness of Professor Edmond O'Neill and his assistants and were made in the chamical laboratories of the University of California.

The calorific values were determined by means of an Atwater bomb calorimeter, and the specific gravity by means of a Westphal balance or a pycnometer flask at about 63 degrees F. Water was determined by distillation.

The resulting values for the heavier fuel oils the writer has collected and plotted as shown in Fig. 1.

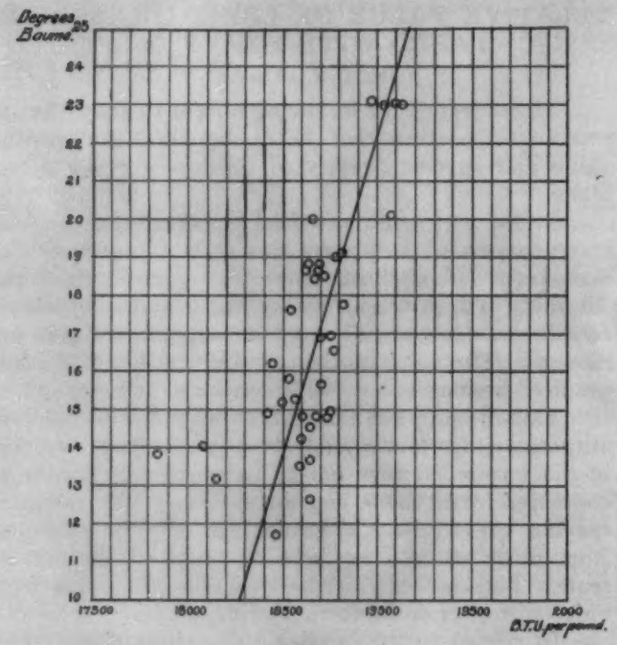


Fig. 1.

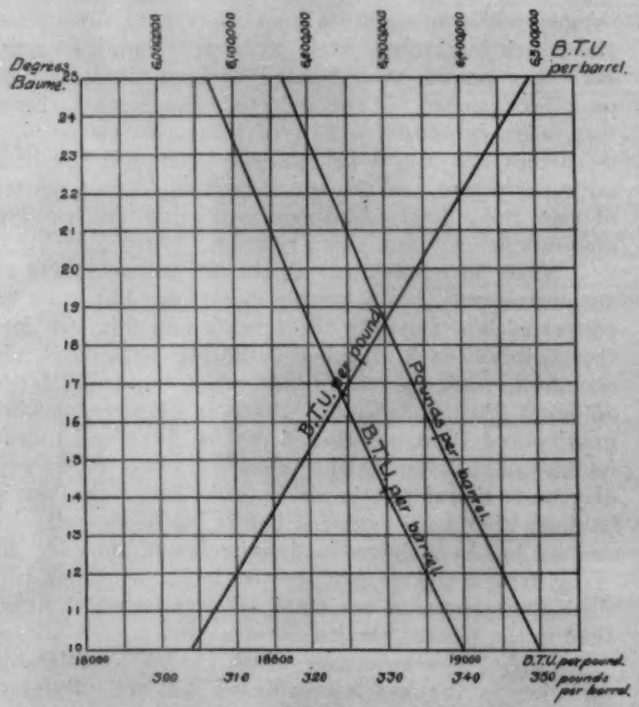


Fig. 2.

The ordinates in this case are degrees of the Baume scale, which is related to the true specific gravity by

$$\text{the relation Sp. Gr.} = \frac{140}{130 + B} \text{ or } B = \frac{140 - 130}{\text{Sp. gr.}}$$

at 63 deg. F. The abscissae are British thermal units per pound of the anhydrous oil. The points, as might be expected, are rather scattered, but can be approximated roughly by a straight line. In drawing the average line through these points the writer has been guided for its position wholly by the points themselves, and for its inclination by the points, and by the table of average specific gravities and calorific values furnished by Mr. R. W. Fenn of the Union Oil Company, whose table covers a wider range of specific gravities than do the determinations gathered by the writer. The average line gives the relative B.t.u. per pound $= 17680 \times 60$ B over the range of these measurements.

Table 1 gives the computed values of B.t.u. per pound, and specific gravity, as well as the weight per barrel, and B.t.u. per barrel, as determined from this average line. Fig. 2 shows the same quantities graphically expressed.

TABLE I.

Degrees Baume.	Specific Gravity.	Weight per barrel.	B.T.U. per pound.	B.T.U. per barrel.	Degrees Baume.
10	1.0000	350.035	18280	6,398,600	10
11	.9989	347.55	18340	6,374,100	11
12	.9859	345.10	18400	6,349,800	12
13	.9790	342.68	18460	6,325,900	13
14	.9722	340.30	18520	6,302,400	14
15	.9655	337.96	18580	6,279,300	15
16	.9589	335.65	18640	6,256,500	16
17	.9524	333.37	18700	6,234,000	17
18	.9459	331.10	18760	6,211,400	18
19	.9396	328.89	18820	6,189,700	19
20	.9333	326.69	18880	6,167,900	20
21	.9272	324.55	18940	6,147,000	21
22	.9211	322.42	19000	6,126,000	22
23	.9150	320.28	19060	6,104,500	23
24	.9091	318.22	19120	6,084,400	24
25	.9032	316.15	19180	6,063,800	25

From these it is seen that although the average heating value per pound of crude oil increases as the specific gravity diminishes, it does not increase so rapidly as the weight per unit of volume diminishes. The heating value per barrel of the heavier oils is therefore greater than that of the light ones.

COMPARATIVE EVAPORATIVE VALUES OF COAL AND OIL.

BY C. F. WIELAND.

While there is undoubtedly a large amount of available information relating to evaporative performance of steam generating plants using coal and oil as fuel, it is usually only valuable in so far as it allows of comparison of different boiler units. It serves chiefly to show the degree of excellence of construction, furnace arrangement, etc., rather than the evaporative value of the fuel itself. Similarly we could hardly expect to judge the value of super-heated steam as a factor of economy from tests made on two engines of widely different designs even though the tests showed high results. On the subject of evaporative values of the fuels in question, there seems to be a dearth of available data.

Coal: It is only in recent years that exhaustive experiments have been made in this country and abroad

to determine the evaporative efficiency of the different coals. The most important of these is the work of the U. S. Geological Survey at its testing plant in St. Louis, now being continued in Pittsburg, which is destined to contribute largely to our knowledge on fuel combustion. Until recently we were accustomed to judge coal almost entirely by its number of B.t.u. and its per cent of ash after correction for moisture. It is on this basis that coal is bought by the U. S. Treasury Department. Moisture, however, being an unstable quantity, can hardly be taken into account except at the moment of firing.

A proximate analysis is usually all that is examined. Such analysis, although giving the percentage of volatile and combustible matter, is hardly in itself sufficient to show its true evaporative value.

Although the volatile content of coals was always known to be the source of greatest heat loss, the nature of these losses and how influenced by the per cent of volatile matter contained, has been but recently investigated by the U. S. Geological Survey and by Constam & Schlapfer in Switzerland. The remarkable coincidence of the results of these tests leaves little room for doubt as to the correctness of the conclusion. Primarily, this is that coals of the same calorific value decrease in evaporative efficiency as their content of volatile matter increases. Constam & Schlapfer show for European coals that the maximum efficiency is obtained from coals having a volatile content of from 16 to 23 per cent of combustible matter. The losses due to the volatile content lie principally in incomplete combustion of the higher hydro-carbons whose action during combustion seems not to be clearly understood. It is assumed that they either pass out of the furnace unconsumed, or, at higher temperature are decomposed into their elements, and under an insufficient air supply or too low an air temperature the liberated carbon passes out of the stack unconsumed as soot.

The combustion of coal may be briefly considered to take place as follows: Under an excess air supply volatile matter is rapidly distilled from the coal at comparatively low temperatures. If the air temperature is not sufficiently high or its volume inadequate the gases pass off unconsumed, in fact do not become ignited. Ordinarily they are ignited, but if the furnace construction is such that they cannot be entirely consumed before striking the cool heating surfaces of the boiler they are again extinguished and the greater part of their heat value dissipated.

The volatile matter having passed off, the remaining C burns to CO_2 with a certain percentage incompletely burned to C O.

The principal loss in our bituminous coals being due to volatile matter, it becomes necessary to observe certain fundamental principles, to efficiently reduce this loss.

(a) The gases must be distilled from the coal slowly and uniformly.

(b) They must then be thoroughly mixed with air of high temperature.

(c) They must be given sufficient space in the combustion chamber to be fully consumed before coming in contact with the heating surfaces.

Mechanical stokers have already done much toward bringing about a slow and uniform evolution of the gases and in doing so have increased the evaporative efficiency appreciably. A further advance would possibly be a gauge in the up-take by which the amount of CO_2 contained in the flue gases could be periodically recorded.

Summarizing the foregoing, it is seen that the greater losses are due to the internal character of the fuel itself and that a special furnace arrangement with its attendant difficulties, based on the above fundamental principles may reduce these losses. Such arrangement will necessarily make the coal burning installation more cumbersome and costly.

Oil: Turning to oil fuel we readily see that the combustion of oil in the furnace is much simplified. With oil as a fuel the manual difficulties met in the hand firing of coal are practically eliminated.

The elements entering into skillful coal firing are not so necessary for oil firing. The reason lies in the nature of the fire itself. A more complete mingling of air and gas is possible. This also depends largely on the construction of the furnace but the elements entering into such construction lie nearer at hand than in coal burning furnaces.

Complete atomization of the oil at the burner tip by a jet of steam or air is of prime importance to combustion. The oil must be thoroughly vaporized before combustion can be complete. This is the function of the burner and is accomplished to a greater or less extent in a variety of burners on the market. It is evident that if the oil is not properly atomized it cannot be readily vaporized and that therefore not only a loss of heat ensues, but there follows an incrustation of the furnace.

Evaporation: In comparing the evaporative values of the two fuels, coal and oil, it is only fair to select a coal that is considered standard and that is largely used in evaporative tests. It would not be just to select a coal of inferior value such as are our western coals.

Therefore, as a basis of comparison, the writer selects Pocahontas coal and Kern crude oil whose analyses are as follows:

Proximate Analysis.	Pocahontas Coal. Per cent.	Kern Crude Oil 14.5 Gravity. Per cent.
Fixed carbon	73.30	
Volatile matter	17.61	
Moisture	.49	.15
Ash	8.60	
	100.00	
Ultimate Analysis.		
Carbon	82.26	87.64
Hydrogen	3.83	10.48
Sulphur	.49	1.02
Oxygen	4.12	.08
Nitrogen	.64	.78
Ash	8.60	
Sludge		none
	100.00	100.00

Calorific B.t.u., 14,067.
Coal data from Naval "Liquid Fuel" board report.

Assuming the complete combustion of the heat values in the two fuels as analyzed and knowing that 1 lb. of C requires 11.6 lb. air; 1 lb. of H. requires 34.8 lb. air; and 1 lb. of S. requires 4.3 lb. air, we have as

the volume of chemically required air for the combustion of the coal and the oil the following:

	Weight of air required. Coal.	Oil.
Carbon.		
Coal. 11.6 lb. air x .8226 lb. C.....	9.54	
Oil, 11.6 lb. air x .8760 lb. C.....		10.16
Hydrogen.		
Coal, 34.8 lb. air x .0389 lb. H.....	1.35	
Oil, 34.8 lb. air x .104 lb. H.....		3.62
Sulphur.		
Coal, 4.3 lb. air x .0049 lb. S.....	.02	
Oil, 4.3 lb. air x .010 lb. S.....		.04
Pounds of air required	10.91	13.82
Weight of combustibles (aftetr deducting ash from coal)	.91	1.00
Total weight, which we will consider as dry chimney gas	11.82	14.28

For our comparison we will make the following assumptions:

1. Flue gas temperature is the same in both cases, viz. 500 deg.

2. Moisture in the two fuels is the same.

3. Air intake temperature (temperature of fire room) 70 deg.

The flue temperature as placed at 500 deg. is probably the mean which obtains in practice; lower results have been obtained, but numerical value makes little difference in our comparison.

Moisture, as shown in the selected coal, is low and that in the selected oil is also low, in most oils it is more nearly an average of 5 per cent; for this reason we will consider that the moisture content is the same in each case.

The sensible heat carried away in the flue gases in the case of the coal is:

$$.24\ (500\text{-}70) \times 11.82 = 1219.8 \text{ B.t.u.}$$

In the oil $.24\ (500\text{-}70) \times 14.82 = 1529.4$ B.t.u.

.24 being the specific heat of the chimney gases.

In the combustion of hydrogen to water each lb. of H. results in 9 lb. of water, or in our coal the water formed will be $.038 \times 9 = .34$ lb.

The heat loss both latent and sensible in the evaporation of this water is: $.34\ (142 + 966 + 288 \times .47) = 422.6$ B.t.u., wherein 212 deg.—70 deg. = 142 assuming the temperature of the water in the coal to be that of the fire-room and 966 being the latent heat of the formation of steam at 212 deg. and of expansion against the atmosphere, and 500 deg. — 212 deg. = 288 being difference between steam at 212. deg. and the flue temperature as assumed; and .47 being the specific heat of superheated steam at atmospheric pressure (as in paper "Thermal Properties of Superheated Steam," in Vol. 30 of Trans. A. S. M. E.)

In case of oil we have: $.104 \times 9 = .936$ lb.

Heat loss is:. $936\ (63 + 966 + 288 \times .47) = 1088.5$ B.t.u.

The loss in coal due to ash is 8.6 per cent of total = 1209.7 B.t.u.

A further loss in oil combustion is the heat absorbed by the steam used in atomizing, being in superheating the steam from 212 deg. to 500 deg. Fahrenheit.

This is: $288 \times .47 = 135$ B.t.u.

Tabulating these losses, which for convenience we will call fixed losses, we have:

	Coal.	Oil.
Gases	1219.8 B.t.u.	1529.4 B.t.u.
Combustion of H.....	422.6 B.t.u.	1088.5 B.t.u.
Ash	1209.7 B.t.u. Burner	135 B.t.u.
	2853 B.t.u.	2752.9 B.t.u.

While this calculation is not intended to convey any idea of the actual value of losses in the two fuels, it may however afford a comparison of what we may term fixed losses, within certain limits.

It is seen that the amount of air required for the combustion of coal is less than for oil. This is due principally to the greater hydrogen content in the oil, the carbon content being roughly speaking, the same. Furthermore the combustion of hydrogen requires a proportionately larger weight of air.

On the other hand the greatest loss in the coal is in the ash for in the comparison of the fuels we must consider them "as received." In the oil, loss due to non-combustibles is practically negligible. The loss due to superheating the burner is also small.

In examining our figures a remarkable equality of the total losses is immediately apparent. To what extent this relation would hold for coals of different composition would have to be determined.

Subtracting these losses from the calorific value of each fuel we have:

$$18619 - 2752.9 = 15866.1 \text{ B.t.u.}$$
$$14067 - 2852.1. = 11214.9 \text{ B.t.u.}$$

These last quantities represent the available heat left in fuel for evaporation. From this it would appear that the two fuels under examination had an evaporative value which is in the ratio of 11.2 for coal to 15.8 for oil. For coals equal in quality to that selected, the writer believes that this ratio will generally be correct, lower grade coals having correspondingly lower values. This ratio is maintained in numerous tests.

It is shown in the foregoing that the theoretically required air supply is greater for oil than for coal. This means a greater volume of flue gases hence a greater loss of heat. If we consider however, those coals having a large amount of volatile matter, it is safe to say that the air supply for their complete combustion would be much in excess of that for oil. Not knowing the composition of the volatile matter, we must necessarily figure with a certain indefinite quantity of excess air. In the combustion of oil we are able to supply more nearly that amount of air which is actually chemically required.

From the manner in which the oil is burned, it is evident that a more perfect mixture of air with the gases is obtained. Not only is the air supply easily regulated by hand, but apparatus has been devised to effect the control mechanically and automatically to suit momentary load requirements. Although it does not necessarily follow that a smokeless chimney signifies complete or most economical combustion, it does mean much to our neighbors and one can safely say that such a chimney is more often obtained in connection with an oil burning furnace than with one burning coal.

Evaporative tests have shown that for good coal an equivalent evaporation of 11 lb. represents about the highest average, although there are cases of higher results on record. For oil the highest average yet attained is probably an equivalent evaporation of 16 lb.

In the report of the Naval "Liquid Fuel" board the best evaporation with coal is given as 10.2 lb., while

with oil the best is 14.4 lb. In some forcing tests made some time ago (see Trans. A. S. M. E., Vol XXVI) by Mr. W. F. Dean, which are remarkable for the good reults obtained at that time, an evaporation for coal of 11.32 lb. was obtained. In a water tube boiler under ordinary conditions, using good coal, an average equivalent evaporation of 10 lb. can be considered good practice, although 11 lb. and slightly over is often obtained. Such results as these, it must be borne in mind, can only be obtained with the best grades of steam coal, similar or superior to the grade selected by the writer for comparison.

With oil fuel, in connection with water tube boilers, records show an equivalent evaporation of 14 to 16 lb. Test records in the writer's possession range from 13.6 to 15.4 lb. Latter is the record of the performance of a 150 h.p. Heine boiler in San Francisco. The oil used had a calorific value of 18,629 B.t.u. Gauge pressure 119 lb. Feed temperature 69 degrees. Flue gas temperature 480 degrees. Percentage of steam used for burner 2.8 per cent of total water evaporated or 0.36 lb. of steam per lb. of oil; 15.4 is the value after correction for steam to burner. Incidentally the efficiency of the unit is 79.8 per cent.

The figures given in the foregoing for oil can hardly be said to be due to any extraordinary construction or arrangement of furnace although care may have been shown in the selection of the burner.

In a series of eight tests made with a 66 in. by 16 ft. horizontal return tubular boiler, having 176, 2 in. tubes and using Coalinga oil of 22 gravity, 18,900 B.t.u. per pound of oil, the average evaporation of water from and at 212 deg. was 15.32 lb. The average h.p. developed at rate of 34.5 lb. of water per hour was 262.5.

The theoretical evaporation of the Coalinga 22 gravity oil, 18,900 B.t.u. per pound, being 19.56 lb. of water per pound of oil and the actual results having been an average evaporation of 15.32 lb., the fuel efficiency for this particular boiler was 78.5 per cent.

It is the writer's opinion that with a few more years' experience and a more refined and perfected fireroom and furnace arrangement, we will be able to reach evaporations closely approximating the theoretical limits. The ease of manipulation of the fire and the possibility of practically exact regulation of air supply for complete combustion, lend to oil fuel evaporative qualities that can be found in no other raw fuel.

FURNACE ARRANGEMENT FOR USING OIL AS FUEL.

BY C. R. WEYMOUTH.

In a paper presented at the New York meeting of this Society, December, 1908, Vol. 30, Page 797 of the Transactions, the writer gave various data regarding California fuel oil, air required for combustion, the various losses in oil firing, and a description of an automatic system for the regulation of boilers fired with crude oil. Although the subject assigned properly includes the question of air supply for combustion, the writer, by reason of his former paper will devote himself mainly to the question of furnace design, and this only for stationary water-tube boilers.

About twelve years ago the low cost and certainty of supply of crude oil led to its general use in California boiler plants. At that time, with a few notable exceptions, there were none but the crudest methods for burning oil, the owner usually employing one of the numerous improvisors of oil burners to convert his plant. This operation usually consisted in introducing a burner through the fire doors and covering the grates with fire brick. This plan was occasionally modified by the introduction of different forms of fire brick arches, target walls, checker walls, etc. Many of these converted coal burning furnaces caused frequent burning out of boiler tubes, due to the localization of heat; gave a limited overload capacity; and by reason of various defects of furnace design, coupled with a general ignorance of the question of oil burning, gave in most instances little better than mediocre results.

During the early period, Mr. E. H. Peabody of New York, a member of this Society, then testing engineer of the Babcock & Wilcox Co., began the first extensive engineering investigation of the merits of various type of furnaces, burners, etc. After an extensive series of tests, lasting nearly two years, Mr. Peabody developed an oil furnace bearing his name, now in general use with certain types of water tube boilers.

Mr. Peabody's tests indicated that while there are differences in various types of burners, these are relatively unimportant; that the proper design of furnace is of supreme importance, as determining efficiency and capacity of boilers and immunity from shut down owing to tube burn outs, etc.; that fire brick arches and target walls are not only needless in securing high furnace efficiency, but a menace to continuity of operation, owing to the impossibility of even the best grades of fire brick withstanding the intense heat of an oil furnace; that furnace depth and furnace volume are determining factors affecting furnace efficiency and capacity, and affording protection to the boiler heating surface, particularly when the character of boiler feed water gives rise to an accumulation of scale inside of boiler tubes; that the shape of furnace and path of flame must be such as to provide a nearly uniform distribution of furnace heat over the largest possible portion of boiler heating surface, as distinguished from an arrangement, causing the direct impingement of flame on a few inches of the tube length; that a large surface of heated fire brick is essential to the maintenance of a high furnace temperature and complete combustion of oil; that air for combustion should be admitted through carefully planned openings in the floor of furnace in such a manner as to provide the most intimate contact of oil flame and incoming air, and thus reduce the air supply to a minimum; that the flat flame or fish tail burner provides for the most economical use of air for combustion; and that when all these requirements for highest economy are observed, the furnace flame has not the bright incandescence sought by the pioneers in oil burning, but surprisingly borders on an orange red.

In the Peabody furnace the bridge wall is set back from the boiler front to give a depth of from eight to ten feet, depending on size of boilers. The burner is of the back shot type, inserted from the boiler front, under the floor of furnace, turning up at the bridge wall. It shoots the flame forward toward the front

of the boiler, so that this wall should have an extra course of fire brick set in place without fire clay, affording an added protection to the front wall. With boilers having tubes inclined downwards, from the front toward the rear, there is thus provided a furnace design, of a shape giving the necessary increased volume as the flame slows away from the burner, providing a gradual distribution of the furnace heat over the tubes the full length of the furnace, there being at no point a direct impingement of flame.

At its front end, except in special boilers, the furnace should have a height of not less than six feet and for large size boilers the height should be from seven to eight feet, depending on character of feed water and desired overload.

Under ordinary firing, the flame should not extend into the tubes, but at forced firing the flame will extend part way through the first pass.

Under Babcock & Wilcox boilers, Mr. Peabody's record performance of 1903 was 83 per cent efficiency at rating, based on 10 sq. ft. of heating surface per boiler horsepower; and an overload capacity of 110 per cent above rating.

During the boiler trials at the Redondo plant, Dr. B. S. Jacobus, a member of the Society, obtained boiler efficiencies on large Babcock & Wilcox boilers, which exceed any published records, the details of which he will soon make the subject of a special paper, to be presented to this Society.

When admitting a large excess of air and an ordinary amount of oil, the flame length will be a minimum, and the temperature of incandescence will be reached at the surface of the envelope separating the vaporized oil and air for combustion. This bright flame is sought by the untrained fireman, but it results in a large loss of fuel, as the subsequent mixture of the products of combustion with the excess of air not in contact with the flame results in a lower mean furnace temperature, which temperature determines the boiler efficiency.

With economical firing the flame lengthens before coming in contact with sufficient air for complete combustion, and with the highest furnace efficiency this temperature varies from 2500 to 2800 degrees Fahrenheit.

Due to the high furnace temperature with oil fuel, as also with coal, the location of furnace relative to boiler heat absorbing surface becomes of utmost importance, not only on account of the loss of heat, due to excessive travel and consequent radiation from furnace walls, but also by reason of the large amount of heat absorbed by direct radiation as distinguished from convection. Consequently the first pass of the boiler should be located directly over the furnace, providing the most direct transmission of the heat generated, both by convection and absorption of radiant heat.

Owing to the large area of incandescent fire brick surface, the radiant heat is uniformly diffused over a large heating surface and the amount of heat thus absorbed becomes an important factor in determining the efficiency of boiler heating surface; for while no heat can be ultimately lost, the greater the heat absorbed in the first pass of the boiler, the lower will be the temperature of gases on entering the second pass, and finally the latter passes of the boiler are able to accomplish greater cooling of the products of combustion resulting in the lowest possible stack temperature; hence the maximum absorption efficiency of boiler.

The time allowed for this discussion is not sufficient to cover other practical considerations in furnace design, such as the number of burners per furnace, arrangement of burners in furnace, arrangement of checker work for air supply, peep hole doors, etc.

While there are inevitable losses in furnace efficiency and boiler efficiency, when operating on a commercial load under ordinary firing, it is the writer's belief that under test conditions the practical limit of boiler and furnace efficiency with oil fuel has already been attained. Considering the ideal nature of oil fuel, by reason of which one can under test conditions, with proper furnaces, cut down air supply to nearly the required theoretical quantity, one might reasonably inquire the reason for the inability to attain still higher furnace and boiler efficiencies. The answer is at once found in the chemical analysis of oil fuel and the large hydrogen content. If it were possible to obtain and burn liquid carbon with the minimum air supply required for oil fuel, maintaining the same radiation and unaccounted-for-losses, and the same terminal temperature of boiler gases, it would be possible to attain a gross boiler efficiency of approximately 90 per cent.

It is still the universal practice in this country to report the heating values of fuels as that shown by a calorimeter test which, as is well known, indicates the total heat of the fuel, including the latent heat liberated by the condensation of the steam formed by the combustion of the hydrogen content, instead of the available heat. If boiler efficiencies with oil fuel were reported on the basis of "available heat," test performances already secured would also indicate boiler efficiencies approximating 90 per cent.

For these reasons it is possible to obtain higher boiler and furnace efficiencies with crude oils of low gravity and least hydrogen content, than with oils of lighter gravity high in hydrogen; and this conclusion is borne out by tests.

PRACTICE AS TO SIZE OF STACKS WITH OIL FUEL.

BY J. P. DUNN.

The question of stack areas and draft depends on the quantity of fuel burned and the necessary draft required. In coal burning we have the necessary draft required to overcome the friction of the fuel bed, which runs anywhere from 35 to 70 per cent of the total draft head. This is eliminated in oil burning furnaces, and consequently a shorter stack will answer. From 80 to 100 feet is all that is necessary. In coal-burning plants stack sizes are accepted which are based on 5 lb. of fuel per boiler horsepower. If with that stack we change to oil we have 2½ lb. per boiler horsepower; and considering that oil can be burned with a smaller amount of excess air than coal, we have virtually two to one, and the stack area would be sufficient for double the horsepower. There are a great many stacks that are operating successfully on

a basis of fifty per cent of Kent's Table. I have a record of one stack that has been forced to the limit, which shows 35.7 per cent. In this particular plant, when they reach that point the pressure under the furnaces is so great that the gases pass out through the cracks in the setting and through the boiler bridging. There is one point in connection with that, which I do not believe is given the attention that it should, it is the question of bridging area; ordinarily the effective area is not considered, as in many plants the bridgings are narrow and long, and in several instances that I know of the effective areas are in the neighborhood of 70 to 80 per cent of what they should be. I know this to be a fact because I have been up against the same propositions. We can take it as standard practice that fifty per cent of stack areas of Kent's tables are ample for oil fuel.

MARINE USE OF FUEL OIL.

BY J. H. HOPPS.

As a fuel for steamships, petroleum has many advantages besides that of low cost. The most important of these are:

(1) The saving in labor and consequent reduction in the number of firemen. The amount of money saved varies with the size of the ship and the number of firemen carried. In installations of average size, one-third the number of firemen and coal passers necessary when burning coal would be sufficient when burning oil.

(2) Reduction in weight and bulk of fuel, giving increased cargo capacity and resultant greater earning power. Comparing "Wellington screenings," a type of coal generally used for steamship work on the Coast and fuel oil from 14 to 17 Baume, oil for equal heating value occupies about one-half the space taken by the coal and has less than one-half the weight. Oil may be carried in parts of the ship not otherwise useful.

(3) Saving in time. The time consumed in coaling and expense of moving to bunkers is saved as oil fuel can be pumped into the ship when she is at the dock and while the cargo is being taken on or discharged.

(4) Uniform steaming. The rate of steaming can be kept perfectly uniform, there being no loss due to cleaning fires, etc.

(5) Cleanliness. Due to the absence of coal dust and dirt when coaling and to the absence of ashes in the fireroom.

(6) Reduced cost of maintenance. Less repairs on boilers due to uniform temperature in furnace and combustion chamber; no corrosion of floor plates, fire fronts, or bunkers; no grate bars to burn out, and no fire doors or ash handling machinery to renew or repair.

That the advantages of oil as fuel are recognized is evident from the large number of steamers using it. Some of these vessels are of large size and make long voyages; notably, the ships of the Hawaiian American Steamship Company, the steamers Tenyo Maru and the Chiyo Maru of the Toyo Kisen Kaisha Company, the steamers "Sierra" and "Mariposa" of the Oceanic Steamship Company, and the numerous large tank steamers owned by the Standard Oil, Associated Oil and Union Oil Companies.

The comparative cost of coal and oil for fuel depends on the price of the fuels and the heat values of coal and oil respectively. Conditions in California are especially favorable to oil. Coast coals are high in price and low in heat values, while oil is low in price and high in heat value. It is not possible to give exact figures as to the saving effected by the use of oil in preference to coal for fuel as the prices of both are constantly changing.

Some instances, however, may be quoted. In the report of the Naval Liquid Fuel Board, published in 1904, figures are given covering the performance of the steamship "Nevadan" of the Hawaiian-American Steamship Company. The figures given cover one voyage from New York to San Diego, burning coal, a return voyage from San Diego to New York burning California oil, and three other voyages burning oil. The records of the two first voyages are of value as showing the relative consumption of coal and oil under similar conditions. Full particulars are given of both voyages, but for present purposes it is sufficient to quote the following:

Total Indicated H.P.	Fuel.	Total consumption of Fuel.	Coal per I.H.P.	Oil per I.H.P.
Voyage 1—1835	Coal	2269 tons	——	——
Voyage 2—2196	Oil	9126 bbls	2 lb.	1.1 lb.

The heat value of the coal used in the first voyage is not given, and as a consequence the comparison is not so effective as it might be. Of the total coal burned, part was Eureka and part Coronel. The figures given for the second voyage may be said to represent an exceptionally fine performance. The steamer was new, is fitted with triple expansion engines, the Howden system of forced draft, and the Lassoe-Lovekin oil burning system.

Burning oil, six men were required in the fireroom as against fifteen when burning coal. Four hundred and fifty-seven tons of measured space for cargo was saved on account of the decreased bulk of oil fuel. The financial gain to the company from all causes is given as $500 per day.

In the case of a small coasting steamer coming under the observation of the writer, careful records were kept of the fuel cost, both with oil and coal. The cost of fuel per hour of actual steaming averaged, for a period of six months:

Coal at $5.25 per ton ..... $2.65 per hour
Oil at .70 per barrel ..... 1.64 per hour

It is to be regretted that few tests have been made to determine the efficiency of steamship equipments. It is more difficult to make such tests on board ship than in a stationary plant. The installation of apparatus for accurately measuring fuel and feed water, the changing of the piping, and the services of trained observers entails heavy expense and loss of time.

The only guide then to the efficiency of oil burning installations at sea in actual service, is the engineer's log, and this, unfortunately, is far from accurate. The oil burned is determined by sounding the oil tanks and as a rule the only clue to the h.p. developed is the number of revolutions made by the main engines, the h.p. of the auxiliaries being always a matter of uncertainty.

In 1903 a series of tests were made by Mr. T. W. Ransom on the tugs "Richmond"and "A. H. Payson," owned by the Santa Fe Railroad Company. As these vessels ply only on San Francisco Bay and in smooth water, the installation of platform scales to weigh the feed water and fuel oil was feasible. The tests were made with great care, a number of observers being employed and all essential data recorded to show the efficiency of the entire installation and the efficiency of boilers and engines, separately. The detailed data secured was destroyed in the fire of 1906, there remaining only a summary of the results.

The machinery of the two vessels is identical with the exception of the boilers.

The tug "Richmond" is fitted with a boiler of the Scotch marine type, 13 ft. mean diameter by 11 ft. long, with three Morrison furnaces 3 ft. 6 in diameter by 7 ft. 10 in. long and 230 tubes 3½ in. diameter by 7 ft. 10 in. long. The depth of the combustion chamber is 36 in. and the total heating surface is 3136 sq. ft.

The "A. H. Payson" is fitted with a Babcock & Wilcox marine water tube boiler, with a total heating surface of 2770 sq. ft.

The engines in both cases are compound, high pressure cylinders 20 in. diameter, low pressure cylinders 43 in. diameter and stroke 24 inches.

A large number of tests were made on these vessels in service, when towing car-floats to and from Point Richmond. In addition, a five-hour test running steadily without a tow was made on each boat, when the following results were secured.

FIVE-HOUR RUN—TUG A. H. PAYSON—AUGUST 2, 1903.

Time	Rev. Per. Min.	Horse Power	Water Used	Oil Used	Water Evap. Actual	Water Evap. From & at 212°	Factor of Evap	Water per I.H.P.	Oil per I.H.P.	Speed Knots
11.00										
12.00	95.3	535	11475	853	13.4	14.68	1.095	21.4	1.59	
1.00	96.0	523	11326	837	13.5	14.77	1.094	21.6	1.60	
2.00	94.5	509	11418	809	14.1	15.32	1.087	22.4	1.58	11.72
3.00	95.5	498	11300	826	13.6	14.66	1.078	22.9	1.65	10.63
4.00	96.4	537	12251	845	14.6	15.84	1.085	22.9	1.56	11.65

FIVE-HOUR RUN—TUG RICHMOND—AUGUST 24. 1903.

12.00										
1.00	91	418	9532	829	12.2	12.80	1.140	22.8	1.98	
2.00	92	424	10331	835	12.4	14.10	1.143	24.3	1.97	
3.00	91	418	8831	806	11.0	12.55	1.140	21.1	1.92	11.08
4.00	91	418	10496	833	12.2	13.90	1.140	25.1	1.99	10.04
5.00	91	418	9627	865	11.2	12.90	1.150	23.0	2.06	10.75

AVERAGE FOR FIVE HOURS' RUN.

Payson.	95.5	520	11553	824	13.8	15.05	1.089	22.2	1.59	11.15
Richmd	91	419	9743	833	11.8	13.05	1.142	23.2	1.96	10.47

From examinations of the logs of numerous steamships, it appears that vessels fitted with triple expansion engines developing from 1000 h.p. up, with everything in first class condition, the fuel consumption will be about 1¼ lb. of oil per i.h.p. hour. For smaller vessels fitted with compound engines, the consumption will range from 1.6 to 2 lb. per indicated h.p. hour, depending on the efficiency of the plant.

In considering the installation of an oil fuel equipment, the subject is naturally divided into two parts. The first relating to the storage and handling of the fuel and the second, relating to arrangements for its combustion.

Under the first division, the safety of the ship and those on board is the first consideration, and after this comes convenience in handling fuel and accessibility of all the important parts.

Under the second division should be considered the system for burning oil, type of burners, and furnace arrangement.

In order to render a fuel oil installation safe, careful attention must be paid to the construction of the tanks in which oil is stored. Not only should the best workmanship, the best methods of support and the best quality of riveting be insisted upon, but great care should be exercised in the design of the ventilation system. Air pipes should be fitted to all tanks, of sufficient size to lead off gases as they accumulate and to prevent any undue pressure on the tanks due to too rapid pumping when they are being filled. The ventilating pipes should be lead as directly as possible to above the uppermost deck of the vessel. They should not be near the smokestack and should be placed where it will be impossible for a naked light to be near them. The openings should in all cases be covered with wire gauze carefully secured. Furthermore, the workmanship on all pipes, valves, and fittings should be of the very best quality. Great care should be taken that all joints are tight, as the leakage of a very small quantity of oil may result in a formation of a large volume of gas from which a disastrous explosion or a serious fire may result.

In a steel vessel fitted with double bottom, the fuel oil may be stored in the compartments in the double bottom usually devoted to water ballast, or in deep tanks constructed for the purpose and usually extending entirely across the ship. The former method is open to several objections, but is often adopted, owing to its low cost and saving in space, where deep tanks are used, expansion trunks should be provided.

In the case of wooden vessels, separate steel tanks independent of the structure of the ship are provided. The location of these tanks varies greatly, depending on the trade in which the ship is engaged, and the preference of the superintending engineer. They are frequently placed in the space formerly occupied by coal bunkers, in the fore-peak, and often, on deck.

The use of the double bottom for oil fuel is open to several objections. The tanks being shallow and divided into a very large number of compartments by the floors, keelson, and intercostals of the ship, it is very difficult to completely fill them owing to the amount of air trapped in the different compartments. It is also impossible to empty them entirely and when a tank is only partly filled, trouble may be experienced in pumping out the oil when the ship is rolling. Again if the ship has to go far north or south where the water is cold the oil in the double bottoms congeals and diffiulty is experienced in pumping. With many cargoes it is necessary to fill the compartments of the double bottom with water ballast when the oil is pumped out and this means that at all times there will be a considerable quantity of water present in the oil. When the double bottom is used, it is necessary to provide settling tanks in or near the fireroom, into which the oil is pumped from the ballast tanks, before being pumped to the burners. The object of these settling tanks is to permit the removal of any water which may have found its way into the oil tanks, or which may be in the oil when it is loaded. These settling tanks should be of sufficient size to contain from eight to twelve hours supply. They should be in duplicate and fitted with steam coils for heating

the oil, gauge glasses to show the amount of water in the bottom of the tanks, and connections for the oil pumps and for pumps to draw off water which has settled out from the oil.

Oil Burning: The important features of this part of oil burning equipment are the atomizer and the furnace arrangement. On these depend the efficiency of the system. The importance of proper furnace arrangements with means of controlling and directing the supply of air and fuel has been emphasized in previous discussions. In the case of marine installations, it is not always possible to secure the best furnace arrangement. Nearly all the steamers in commission today are equipped with boilers of the internally-fired type. With the short cylindrical furnaces of comparatively small diameter used on these boilers, it is difficult to secure the highest possible efficiency when burning oil. They are well adapted for the burning of coal.

For the burning of oil, it is well known that ample combustion space is needed. With a large combustion space, greater time is available and more opportunity for the oil particles to take up their requisite supply of air for combustion. Further, it is important, as has been pointed out, that the direction of the incoming air current should be such as to cause an intimate mixture of the air supply and oil particles as early as possible. With the short cylindrical furnaces these conditions are difficult of attainment. The air and fuel are admitted in sensibly parallel paths. The furnace is short and of small diameter, hence, the time during which fuel and air are in the furnace is very short. In consequence, complete combustion is difficult and is always delayed. With water tube boilers, the furnace conditions are superior, and as may be expected, higher efficiencies have been shown.

Atomization: Three systems of atomization are in use in marine installations, namely: Steam, Air and Mechanical.

Of these, by far the greater number of installations in use on the Pacific Coast are of the second order. The use of steam for atomization is confined to vessels plying in inland waters, or on very short runs. It is not suitable for vessels making voyages of any length because of the large amounts of fresh water necessary for boiler feed to make up the loss due to the steam used for atomizing. This feed water must be carried in tanks, thereby reducing the cargo capacity of the ship, or changing the arrangement.

Air is used for atomization in almost all vessels making voyages to sea. The air is used with varying pressures from 1½ to 60 lb. per sq. in., depending on the burner. By far the larger number of oil burning outfits utilize pressures in the neighborhood of 20 lb. per sq. in.; the air being supplied by steam driven compressor, or in the case where low pressures are used, a rotary blower.

The third system, mechanical atomization, quite generally known as the "Koerting" or "Meyer" system, although extensively used in Europe, has not yet been adopted to any extent on the Pacific. The atomization is effected by expelling the oil through a small orifice partly closed by a plug, on which is formed a spiral thread. The edges of the orifice are sharp and the spiral thread imparts to the stream of oil a rapid whirling motion, causing the oil to break up into fine drops which leave the nozzle in a cone of atomized oil upon which the entering air currents impinge.

As has been said earlier in the discussion, little data is available showing the efficiency of marine oil installations. The amount of steam required for atomization will range from 2 per cent to 8 or 9 per cent depending on the type of burner and the intelligence with which it is operated.

For air atomization and with air pressures from 20 to 30 lb. per sq. in., from 6 to 10 cu. ft. of air per minute per pound of oil burned will be required. The amount of air depending on the construction of the burner and the pressure at which it is used.

For air atomization with low pressures, such as can be produced by a rotary blower, of which the Lassoe-Lovekin system as fitted to the steamships of the American Hawaiian Steamship Company, is an example, the amount of air required for atomization is not known. The air pressure used is 1¼ lb., and all the air is heated by the Howden system. The oil is heated to 175 degrees F. As evidenced by the figures given heretofore, for the steamship "Nevadan," this system shows a high efficiency.

A few installations of the third, or mechanical system, have been made on the coast, but no information is available as to the efficiency obtained.

In the opinion of the writer, the mechanical system has not received the attention which it deserves from our local engineers. It should be efficient and its simplicity is certainly a recommendation. I am informed by the agent of the Koerting Company that the oil may be handled by the ordinary pumps installed for that purpose, with other systems, but that an additional heater is necessary as the temperature of oil at the burner should be from 240 to 260 degrees. It is further stated that as long as the pressure of oil at the burner tip is maintained at more than 40 lb. per sq. in. there will be no carbonization in the heating and pipe system, nor in the burner. One hundred lb. per sq. in at the burner is said to be the most desirable pressure for this system.

The makers state that to operate the pumps and supply the heat to the oil necessary with this system takes from ¾ to 1 per cent of the steam evaporated.

Some large tank steamers fitted with the mechanical system are said to operate satisfactorily. The results obtained show that a horsepower is developed for from 1.09 to 1.37 lb. of oil per indicated h.p. per hour, for all purposes. These vessels develop about 1900 h.p.

ATOMIZATION OF OIL FUEL.

BY A. M. HUNT.

In order that petroleum may be burned with complete combustion it is necessary that it be either gasified or injected in the form of spray into the furnace in which it is burned. Some forms of small pan burners have been devised for use in hot air furnaces, where oil drips into the pan, and burns from the surface, but they are of no importance in power or industrial work.

The general practice is to deliver the oil to the

burner under head, and inject and pulverize it, using steam or air as the pulverizing medium.

The oil injected into the furnace should be entirely gasified or burned while it is in suspension in the air, otherwise if particles of unconsumed oil fall to the bottom of the furnace, coke will be formed, which gradually accumulates and builds up.

A number of factors enter into the production of the results required. If the oil is being injected into a cold furnace, that is one not enclosed by walls of brick or other material which becomes highly heated, the oil must be injected in a spray composed of fine particles, in order that none of the particles shall fall to the bottom unconsumed. If the walls are highly heated, the radiation from them will aid greatly in vaporizing the oil particles, and larger particles will be consumed before they drop.

If the furnace is short, the oil particles will have a relatively short time period within which they must be consumed, and must, therefore, be smaller.

It is evident that anything which will enable the oil more easily to be atomized, or that will aid in vaporizing an oil particle after it is injected into the furnace, will help to reduce the quantity of atomizing medium required, whether it be steam or air.

Most of the oils used for fuel are of a heavy and viscous character, and their viscosity is rapidly reduced by rise in temperature. It is, therefore, desirable that the oil fed to the burners be preheated, and it is almost universal practice to do so. The preheating is usually accomplished by passing the oil through a heater similar in type to a closed feed water heater, using the exhaust steam from the pumps handling the oil.

Hundreds of burners have been invented, and great claims have been made by each inventor as to the possible saving to be effected with his particular form. The burner is really an item of minor importance in all oil burning installation, as compared with furnace construction, proper air admission, and other points.

The office of the burner is simply to inject the oil into the furnace in a spray having a form suitable to the shape of the furnace, and the surfaces which are to be heated, and in particles sufficiently small so that they may be fully consumed before impinging on the hot bottom or walls of the furnace.

The burner should be so built that the relative areas of openings for issue of oil and atomizing medium can be maintained, or if they become enlarged by scoring, that adjustment can be readily and inexpensively made.

Some work has been done in the direction of atomizing the oil without the use of air or steam. The oil having been pre-heated to temperatures of from 220 to 260 degrees Fahrenheit is injected into the furnace through a needle nozzle, having a small sized orifice. The portion of the needle stem inside the cylindrical part of the nozzle, has cut on it a screw thread, which imparts to the issuing oil a rotary motion. The release of pressure on the heated oil, and the rotary motion imparted to it, cause it to issue in the form of a spray in a state of sub-division fine enough to enable it to burn successfully.

I give below some data as to amount of atomizing medium required for spraying oil fuel, which has been obtained from various sources.

Data as to Amount of Steam Required for Atomizing Fuel Oil in Boiler Furnaces, Collected From Various Sources.

CASE 1:
Steam to burner per pound of oil ..... .537
Actual evaporation per pound of oil 13148
Percentage 4

CASE 2:
Steam supplied to burners per hour ..... 4373 lb.
Actual evaporation per hour 96881
Percentage 4.5
Steam per pound of oil for atomization ..... .529

CASE 3:
Steam supplied to burners per hour ..... 7087 lb
Actual evaporation per hour 174820
Percentage 4
Steam per pound of oil for atomization ..... .485

CASE 4:
Steam supplied to burners per hour ..... 5746 lb
Actual evaporation per hour 144079
Percentage 4
Steam per pound of oil for atomization ..... .475

CASE 5:
Steam used was measured by use of separate boiler.
Oil used 34½ degrees Baume.
Total evaporation per lb. of oil from and at 212 deg...14.99 lb
Percentage of steam evaporated, used by burner 7.4%

CASE 6:
Steam used was measured by calibrated nozzle.
Total evaporation per lb. of oil from and at 212 deg...14.7 lb
Percentage of steam evaporated, used by burner 2.5%

CASE 7:
Steam used was measured by calibrated nozzle.
Total evaporation per lb. of oil from and at 212 deg...14.2 lb
Percentage of steam evaporated, used by burner 3.6%

CASE 8:
Steam used was measured by use of separate boiler.
Total evaporation per lb. of oil from and at 212 deg...15.2 lb
Percentage of steam evaporated, used by burner 2.39%

From tests made under the direction of the Bureau of Steam Engineering in 1902, the following data is taken:

Four tests were made using steam as the atomizing medium. The percentage of total evaporation used by the burners ranged from 3.98 to 5.77 per cent. A number of tests made under Stirling water tube boilers gave results ranging from 3.1 to 3.42 per cent.

From the above data and general practice and experience, the following statement can be made:

In designing a plant it is entirely safe to assume 5 per cent of the evaporation of the boilers for steam supply for burners. In operation, if the amount is greater than 3 per cent, it may be concluded that the condition can be bettered.

The use of compressed air for atomizing fuel oil may be stated to offer no opportunity for fuel saving over the use of steam direct in cases where steam is available. The use of steam direct obviates complication, and risk of interrupted service, and the use of compressed air is not justified unless there is some special reason for it.

It may be that steam cannot readily be had, and that a motor-driven compressor can easily be installed.

It may be that where steam is available, the loss of water through steam supplied to the burners is undesirable, as in the case of sea-going steamers.

In certain metallurgical and industrial operations, especially where high temperatures are desirable, the use of air is to be preferred.

In rotary cement kilns, using oil fuel, compressed air, as the atomizing agent, is universally employed so far as I know.

Reverberatory furnaces for metallurgical operations, using oil fuel, employ compressed air as the atomizing agent.

Data as to Amount of Air Required for Atomizing Fuel Oil, Collected from Various Sources.

Case 1: Rotary cement kiln, 7 ft. 6 in. diameter by 125 ft. in length, producing about 500 barrels of clinker daily. Air used under pressure of approximately 80 lb. A single burner used, delivering oil at the rate of about 4 gallons per minute. The weight of air required for atomization is approximately 25 per cent of the weight of the oil atomized.

Case 2: Data furnished by air compressor manufacturer as to capacity of compressor furnished for boiler installation of 2500 h.p. Assuming that the entire capacity of the compressor was necessary, this figures out a use of air amounting to approximately 55 per cent of the weight of fuel atomized.

The same manufacturer gives the following data: For marine boilers figure one cubic foot of free air for each five boiler horsepower, the air being supplied at a pressure of about 25 lb. A ten cubic foot compressor at 20 lb. will supply air sufficient to atomize the fuel oil to take care of a boiler furnishing steam heat for a small apartment house. For burning sewer pipe it takes about 5 cubic feet per minute for each burner using about five gallons per hour of oil.

He adds the following comment: "We favor the use of air as hot as we can get it from the compressor, cutting out the water jackets."

Case 3. Reverberatory copper matting furnace. Hearth 80 ft. long by 17 ft. wide. Center of roof arch is about 39 in. above the surface of bath on hearth. Fired from the end using four burners. Amount of material smelted per day, 182 tons. Oil used per day, 36,472 lb. Air for atomizing supplied by a motor-driven Connersville blower at 9 lb. pressure. Amount of air used, about 50 per cent of weight of oil burned.

"OLLA PODRIDA."

BY THE CHEERFUL IDIOT.

Olla Podrida—figuratively means a literary production of very miscellaneous contents.—Encyclopedia.

The session of the California Legislature at Sacramento is drawing to a close. They have left undone those things which they ought to have done, and have done those things which they ought not to have done, and there is no health in them. "Errare humanum est." One thing in particular that they have left undone and which I suppose is of more interest to many of the readers of this paper than anything else at this time, is to act favorably upon the passage of the Engineers' License Law, a measure desired by all the engineering fraternity throughout the State.

I feel like asking here: Why is an engineer? Frankly, I don't know. I can't answer my own question. Should any reader of this paper while walking along our streets see two men meet who are acquainted with each other, he will, if he happens to be in a frame of mind to notice them at all, hear one say to the other, "Well how goes it?" or "How are you, what do you know?" The reply to the last half of the latter question generally being, Nothing! Now when two engineers meet the method of procedure is quite different; they meet in silence; watch them closely. They will approach to within about three feet of each other, and standing still will extend their hands at the level of the waist with fingers closed and thumbs pointing downwards. This is the first position. It is immediately followed by the second. The hands are raised to the level of the breast bone, the arms are extended at full length, fists closed, and placed perpendicularly one above the other. The two men then pass on their respective ways in silence. These are engineers. The first portion of the sign has two meanings, viz: "We are under the thumb," or "We are the under dog." The second portion of the sign means, "We grasp with might and main the slippery end of the stick. Should we let go; it is all off with us." Before I knew what this sign meant, a man made it before me. I thought he was going to have a fit. It doesn't take very long to make it but when thoroughly understood it is very expressive.

Now the engineers of the State of California have been trying to get some sort of a law passed whereby members of the craft should be licensed, for the past 25 years, and they have always gone about the matter in a business-like, upright way, thinking that a law of this kind would be of great benefit alike to the employer and the employee. The funny thing about it is this: that nobody else looks at the matter in the same light. And the opposition encountered by the engineers is wonderful. The first bill prepared about 25 years ago was drawn up by members of the N. A. S. E., who at that time stood alone in the fight. The bill which has failed to pass at this session of the Legislature was jointly prepared by the L. W. S. E. and the N. A. S. E. and was adopted and endorsed by all the union engineers and N. A. S. E. men throughout the State. Of course there were a few individuals who did not endorse it, but majority rules always.

As soon as the bill was submitted to the Legislature the fun commenced. The capitalists and steam users claiming that it was only a "subterfuge," got up by the trades unions to coerce them into paying good wages for services which they could now get cheaply. And the trades unions claiming that the whole thing was a Citizens' Alliance movement designed to get the engineers away from under their thumbs.

Under the circumstances, therefore, it seems to me in my humble judgment, that the poor engineer is in a h—l of a fix. It is entirely wrong to accuse the engineer of trying to "subterfuge" in the case at all. They tried by all honorable means to attain an honorable end.

Not so with the man who wanted to ship a large shipment of limburger cheese by rail. He tried a "subterfuge." In looking over the freight rates he found them to be prohibitive, but in still looking further over the tariff sheet he found he could ship a corpse for half rates. So he bought a cheap coffin, filled it with the cheese, enclosed it in the usual redwood box and accompanied it himself. Having traveled some miles he went into the baggage car to see how his "subterfuge" was getting along. While looking at it the baggage man said:

"Traveling with the corpse, sir?"

"Aha, yes!"

"Relative of yours, I suppose?"

"Aha, yes; my brother."

"H'm; well he's dead alright."

This was a "subterfuge." The engineers' bill wasn't.

Just fancy the peculiar spectacle of a Citizens' Alliance man on one side of the table and a trades union man on the other, in Sacramento, both opposing the engineer. Something ought to have happened. I am looking at this subject, or at least trying to look at it in a disinterested light, and in all fairness to both sides. I masquerade as an engineer and have been in the business in California for nearly 30 years. I have got along during that time without a license. Inasmuch as I shall not live 30 years more, perhaps it won't make any difference to me personally whether I ever get a license or not. But I want to go on record as saying that I sincerely hope that the engineers will obtain what they want sooner or later. The vaporings of a "Cheerful Idiot" perhaps won't help them much, but they have my very good wishes for their ultimate success. What I was going to say, however, was this: Either the Citizens' Alliance should have gone over to the engineers' side tooth and nail to beat the unions—or the unions should have gone over to the engineers in the same way to beat the Citizens' Alliance. As neither one of these things happened, the engineers fell down with great completeness and with a very loud noise. In one of my previous effusions which this paper was kind enough, or otherwise, to print, (which ever way the many readers care to look at it), I stated that I had attended a meeting of our organization at which the subject of a license law was brought up. At that meeting the mention of the license law had the most astonishing effect. Everybody went up in the air like a lot of kites. I was grateful to be allowed to get home with a whole skin. These men seemed to me to be entirely opposed to any measure to license the engineer. I made a speech, and even that didn't do any good, but in my speech I pointed out to them the advantage as I saw it of having a California license for engineers, and on very simple grounds. We have secured the 1915 Fair here. Would it not be much nicer for men who live in the State, many of whom were born and raised in the State and who are in turn raising or helping to raise the future population of the State, to have the engineering jobs pertaining to the "getting ready" of this great enterprise in their own hands, instead of standing around shaking a bunch of keys and a knife in their pockets and admiring the beautiful climate and our beautiful bay, etc., while outsiders do the work?

As an illustration let me cite an example. I once played in a band. We finished a pleasant and prosperous engagement in a nearby town. A few days later and just previous to Labor Day, I met the solo cornet player on the street and asked him if he had anything on for Labor Day. "Oh, yes," said he, "I have a big band for that day, but I need a bass drummer; I think I'll give the job to Frank Moore." "But," said I, "Frank is not a drummer, he is a piano player, and besides he has no drum." "Oh, well," said he, "that don't matter, he can borrow yours." Now, I didn't look at the matter in this light at all. I failed to see how I was going to profit in any way by the arrangement. I was supposed to stand on the street corner, admire our beautiful climate, our beautiful city, our beautiful bay, and so forth, and watch another man making $8 out of my drum.

Nearly all the engineers in the State are affiliated with the union, and the union is affiliated with the Labor Council and the Building Trades Council. The engineers have to pay dues, per capita tax, assessments, strike benefits and what not. They always come through, they have to; but when they try to get up something to better themselves these very organizations oppose them to the limit. The chicken picker won't pick a duck—he goes on strike. What's the proper thing to do under the circumstances? Why, the only logical thing to do is to assess the engineer, and he gets it. Hooligan falls into a sewer and breaks his neck. Up comes an envelope containing ten raffle tickets for his pick and shovel for the benefit of the widow. Now the engineer has no more use for a pick and shovel than a cow has for a fire balloon, but he has to be a good dog and buy a ticket.

A farmer once owned a jackass which he had great trouble in catching in the morning. The only way he could catch him was to go out just at break of day, creep up close and throw a rope round his ass's neck. One morning he went out as usual, but it happened to be very foggy. He crept around in the dark until he saw what he supposed was his ass, lying down. He made a jump; unfortunately, however, he was mistaken. What he thought was his ass was a stone curbing around an empty well. He went over this, landed at the bottom and broke his neck. The coroner's jury subsequently sat on the case, and returned a verdict to the effect that the farmer had come by his death through falling down a well and breaking his neck while looking for his ass. And gave it as their opinion that this was the only authenticated case on record where a man didn't know his ass from a hole in the ground.

I was in Sacramento the night that the engineers' bill was brought up for final action before the Law and Judiciary Committee of the Senate. I don't exaggerate in the least when I say that there were $10,000,000 represented there flanked by the best and most expensive legal talent in the State opposing the license bill. There were two engineers there with perhaps not more than $20 in their pockets, between them. Great chance.

The newspapers look upon the matter in a way which to an engineer seems most peculiar and absolutely illogical, the writer of some of the editorials displaying profound ignorance of the subject he is trying to handle; and the average reporter is just as bad. For instance, "The captain struck eight bells and the huge liner backed out from the dock, 'full draft astern.'" Wonderful! "Eight bells" must always be struck, regardless of time, and by the captain, before the ship is in condition to move. Ain't it awful? And then to go back to the license law. The Chronicle says: "Stationary engineers." "No legislation whatever is required in regard to them." "Whoever hears of the explosion of one of these simple steam boilers such as are used for ordinary hoisting and the like?" The boiler of a logging engine exploded, according to this same paper only a few days ago, resulting, if I remember right, in the death of five or six persons.

Mere trifle—plenty more engineers. Some few years ago the boiler of a hoisting engine exploded on Howard-street wharf. Now listen to this; I know whereof I speak. This boiler was fitted with a safety valve. (The "Chronicle" chuckles considerably over the fact that all these boilers are fitted with a safety valve). This boiler was also fitted with a steam gauge, which registered a pressure of 20 lbs. just previous to the explosion. The engine was not in operation—the engineer was putting it on the blocks and two men were boring holes in the dock to receive the holding down bolts, dock screws as they are called; preparatory to going to work at 1 o'clock. This beastly boiler, without any warning, and at this inopportune time, exploded, killing one man outright and breaking both the engineer's legs. The boiler itself went clean over the topsail yard and landed upon the ballast in the ship's hold, carrying away the main stay in its descent. In this case either the much lauded safety valve or the steam gauge or both were out of order. I suppose this then was an act of God. Poor God, he has a whole lot to answer for.

Some few years ago, and not many at that, the boiler of a hoisting engine on a barge at the Grangers' warehouse at Crockett, exploded at about 12:45 p.m. The barge was made fast outside the ship and they were loading grain. In this case no one was hurt, because no one was on the barge at the time. The engineer was just about to go over the ship's side, in fact, his feet were upon the extreme top step of the ladder. The force of the explosion sank the barge and the boiler came down through the roof of the warehouse and landed on a pile of grain. This boiler, as usual, also had a safety valve. The engineer went crazy and died in an asylum. But, again, this is a mere trifle—plenty more engineers and plenty of work for the shops.

But, to again quote one of the ridiculous assertions made by the writer in the "Chronicle": "It is improbable that in one of these boilers sufficient steam could possibly be generated to cause an explosion." Let us see as to this. The boiler of an ordinary hoisting engine, donkey engine as it is usually called, is about 3 ft. in diameter and 6 ft. high. The pressure usually carried being 125 lbs. per square inch. A very simple calculation, which, even I can make, will show that the total pressure on the shell of this boiler under these conditions is 454 long tons. Also a mere trifle and not sufficient to do any damage to speak of. It may be pertinent here to ask, however, what is the horsepower of a donkey engine? Says the "Chronicle": "Employers do not wish their boilers to blow up and can be relied on to place no incompetent person in charge of them." This is rot. Every man who says he is an engineer is one and remains one until the disaster takes place. His competency cannot be determined at the start. When the thing happens and his competency has been passed upon, the employer says "who'd a' thought it?" This effort of the brain usually being followed by heavy damage suits, which are not trifles from the employer's point of view. The engineers have tried to benefit themselves as well as their employers and have been turned down. Fortunately, the undertaking business is not entirely a lost art.

Not very many moons since a man was scalded to death in the engine room of the "Chronicle" under peculiarly distressing circumstances, though no fault of of his, the accident being one entirely to faulty arrangements. It looks to me as though a boiler inspector would be the proper caper, especially in densely populated districts. I may say here that the engineers as a class have been trying to educate themselves to be better men and more useful members of the community for the past 30 years. If they had spent about 75 per cent of this time in educating the employer, everyone would now perhaps be better off. They commenced at the wrong end.

ASININITY VS. ABSURDITY.

A little further digest of "A Knave or a Fool" illustration in the Journal of Electricity for Feb. 25th, produces a few interesting deductions not mentioned, and tending to enhance the condition of idiocy. To practice an experiment of this nature in a foreign location would be paradoxical enough, to practice it in one's native State shows mental ailment. Presume, with a disregard of illiteracy and fabrication, that this applicant had been employed as an electrical engineer, without recourse to his voluminous references, how long could he have carried out the hypocrisy, how long would he have been in evidence? The ultimate attainment from a proceeding of this character is less than nothing, if such can be reached; nothing might leave at least a good name, here, even this is forfeited, he is known as an impostor, and such an individual, in the most menial position, is not eligible for a reputable business. By an exhibition of asininity in a personified form the man literally kills any business association possibility. The Journal of Electricity is to be commended in its efforts to proclaim such fraud among the profession.

The writer was attracted a few weeks ago by the following "Help Wanted" advertisement, which appeared in a Pacific Coast periodical. Upon perusal the absurdity is manifest.

WANTED—Young assistant for field and office work; civil engineer with knowledge of geology; must be technically educated, rapid worker, but careful, exact and methodical; good observer; experienced in typewriting; good business head; good at map drafting, lettering and note taking; good habits, good walker, good appearance; experienced in meeting business men.

Here is a desire to obtain a 100-point man, the combination of an engineer and business man, embodied in a "young assistant." The essentials requisite appear formidable, even tending to the personal; "good" is used no less than six times, and it is assumed that perfection must be apparent in the qualifications not so prefixed.

The man who could honestly fill this bill must be a little more experienced and a little above the appellation "young assistant"; in truth, the engineer who could so act is hardly looking for a position, unless there is something radically wrong. This is advertising for the impossible, and is tending towards absurdity.

If the desire had been for an electrical man, the applicant given publicity in the Journal of Electricity might have filled the bill. A. J. R.

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POWER AND GAS

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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Fuel Oil

When oil was first produced in commercial quantities in California coal users saw its possibilities as a cheap fuel provided that the supply was dependable and their furnaces could be adapted to its use. These doubts have long since been removed from the minds of the operators of industrial plants, locomotives and steamships, but there are still timid investors who hesitate to lend their assistance to industrial development dependent upon fuel oil. It is to such doubting Thomases that we commend a careful reading of the papers presented at the San Francisco meeting of the American Society of Mechanical Engineers.

As to the all important question of oil supply, Mr. Arthur F. L. Bell gives a conservative analysis of facts and figures from which the layman may readily disprove the bugaboo of oil failure. A calculation of the known and producing oil sands show that we have little to fear and that we may proceed with the development of our industries with the same confidence that the New Yorker feels in his fuel supply for the next year.

Coal furnaces have been satisfactorily adapted to oil burning, but there yet remains the popular fallacy disproved in Mr. A. M. Hunt's paper It was long held as obvious that the brightest flame was the most efficient, apparently giving off the most heat. In this paper it is shown with such a flame much fuel passes out of the stack unconsumed, whereas a red and smoky flame receiving a proper air supply, gives off the most heat. Many firemen have undoubtedly discovered this feature and profited thereby, but there are certainly many more who should educate themselves to this practice.

The further statement is made that the burner has less to do with the economic use of fuel oil than the form and design of the furnace. Scores of oil burners which have been developed represent a tremendous waste of inventive genius. How often does the enthusiast guarantee his burner as a panacea for all furnace troubles! While it is true that the burner must produce a spray of proper form and fineness under good control, the best results cannot be expected without a furnace suited to the conditions of each installation. This requires a technical knowledge of high order and is a fruitful field for further study in perfecting this branch of the art. The most needed burner improvement is some method for reducing the high cost of forcing oil through the burner, which now represents an outlay of about four per cent of the boiler power. Such papers and discussions as presented at this meeting are one of the best means of focusing competent attention on the problems to be met and bringing about needed improvements.

PERSONALS.

T. C. Ryland, of the Ryland Corporation of San Jose, was a recent San Francisco visitor.

C. L. Cory returned to his San Francisco office last Friday after a trip to Los Angeles on engineering business.

Thomas D. Campbell, general manager of the street railway system in Grand Forks, South Dakota, is a San Francisco visitor.

S. T. Wellman, president, and F. H. Bostwick, western manager of the Wellman-Seaver Morgan Company, are at San Francisco.

R. C. Gillis, president of the Mount Hood Railway & Power Company of Portland, has been spending a few days at San Francisco.

J. W. White, sales engineer of the San Francisco branch of the Fort Wayne Electric Works, left for Los Angeles during the past week.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company, returned to Milwaukee last week after making a tour of the Pacific Coast.

Sidney Sprout returned to San Francisco last Wednesday, after spending several days at Sebastopol, Sonoma County on electrical engineering work.

E. L. Haines, one of the electrical engineers connected with the Pacific Coast branch of J. G. White & Co., left for the Eastern States last Sunday to recuperate after his recent illness.

F. O. Sievers and J. A. Herr of the sales departments of the Fort Wayne Electric Works and the Sprague Electric Company, respectively, spent the past week in the San Joaquin Valley.

Julian Adams has been appointed engineer in charge of power supply and electric distribution for the Pacific Electric Railway and the Los Angeles-Pacific Company of Los Angeles, Cal.

R. W. Van Norden has returned from an examination of the new Coleman plant of the Northern California Power Company in Shasta County, which is being erected in accordance with his designs.

Arthur Caldwell, who was formerly an engineer with the Pacific Telephone & Telegraph Company at San Francisco, has become manager of the California Electrical Construction Company of San Jose.

William F. Smith has been appointed engineer in charge of substations and overhead maintenance of way for the Pacific Electric Railway and the Los Angeles-Pacific Company of Los Angeles, Cal.

George R. Field, assistant general manager of the Great Western Power Company, recently returned to his San Francisco office after an inspection trip over the hydroelectric transmission system.

W. W. S. Butler, manager of the Western States Gas & Electric Company, one of the H. M. Byllesby corporations, with headquarters at Stockton, was a San Francisco visitor during the past week.

William Hoopes, the electrical engineer of the Aluminum Company of America, arrived at San Francisco last Thursday after a tour of the Pacific Northwest and made his headquarters with Pierson, Roeding & Co.

E. V. D. Johnson, general manager of the Northern California Power Company, has returned to his headquarters at Redding after spending a few days at the San Francisco office of the corporation in conference with President H. H. Noble.

R. D. Holabird, president of the Holabird-Reynolds Company returned to San Francisco last week, after an extensive Eastern tour. Mr. Holabird attended the conventions of the electrical jobbers and visited a number of the manufacturing plants.

L. E. Ashbaugh, one of the hydraulic engineers attached to the San Francisco office of J. G. White & Co., will soon leave for London for an assignment with J. G. White & Co., Ld., on a Brazilian hydroelectric project. He spent some time in Brazil last year in connection with an engineering enterprise.

F. H. Reed, first vice-president of J. G. White & Co., who is in charge of the company's financing, is spending a few days at the San Francisco branch office. Several years ago Mr. Reed financed the Manila Railway & Light Company, operated by J. G. White & Co., and the Philippine railways, but this is his first visit to California.

Frank D. Beal has opened offices as consulting wood preserving engineer in the Central Building, Seattle, Wash. Mr. Beal was with the Southern Pacific's wood preserving department for eighteen years, resigning as superintendent of their West Oakland creosoting plant in 1906 to take up similar work in Washington.

Colonel Frank H. Ray of New York, arrived at San Francisco last week and later proceeded to Medford, Ore, where preparations are on foot for extensions of the Rogue River Electric Co. The company is in the market for one or two additional 5000 kw. generators for installation at the present hydroelectric plant. It is understood that during the coming year work will be commenced on a new power plant, 30 miles farther up the Rogue River, which will cost about one-million dollars.

Frederick S. Pearson of New York, who has been connected with the construction of a number of electric power, light and railway plants in North and South America, spent a few days at San Francisco on his way to Mexico with a party of capitalists. Dr. Pearson is at the head of the tram way companies of Rio Janeiro and the City of Mexico and of the light and power companies of the latter city. He is also president of the North Western Mexican Railway. C. H. Kearney and F. H. Huntriss of Rio Janeiro, Walter Gow of Toronto, V. A. Webenberg of New York, and F. Blackmon and Theodore Hubbard of London are in the party on the way to inspect their Mexican properties.

MEETING NOTICES.

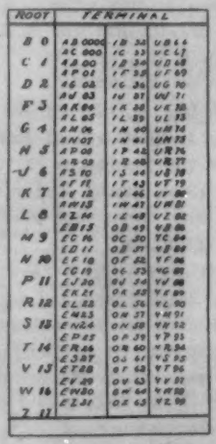
The Los Angeles Section of the American Institute of Electrical Engineers will discuss "Uniform Specifications for High Tension Line Crossings" at the meeting of March 28th to be held in Blanchard Hall, 231 South Broadway, at 8 p. m.

The March meeting of the San Francisco Section of the American Institute of Electrical Engineers will be held in the Home Telephone Company's building at 333 Grant avenue, 8 p. m. March 24th. Prof. E. G. Cottrell of the University of California will speak on the "Electric Precipitation of Smelter Fume."

The Oregon Society of Engineers was organized at Portland last month with a charter membership of 160, D. C. Henny, consulting engineer of the U. S. Reclamation Service, being elected president; O. B. Coldwell, general superintendent of the power department of the Portland Railway, Light & Power Company, first vice-president; W. R. King, consulting hydraulic engineer, second vice-president; William H. Corbett (deceased), president of the Willamette Iron & Steel Works, third vice-president; C. E. Bliven, secretary; F. A. Naramore, assistant engineer of the Northwest Bridge Company, treasurer; Thomas Bilyeu, J. H. Norton and M. Quimby, one-year term directors; H. E. Plummer, A. D. Monteith and B. Honeyman, two-year term directors, and Ralph Budd, Frederick Powell and E. P. Rawson, three-year term directors.

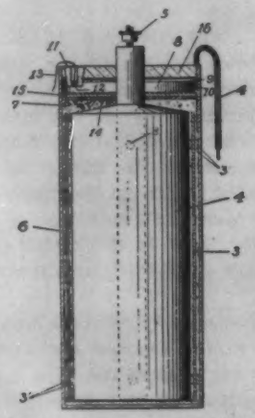
PATENTS

986,400. Telegraphic Code Concentrator. Charles Wood McDonald, San Francisco, Cal., assignor to International Key-code Company, San Francisco, Cal. In a cipher code, the combination with a sheet divided in any suitable manner into a root part and a terminal part, the root part consisting of a series of single consonants and their appropriate numbers, and the terminal part of a series of two letter syllables beginning with a vowel and ending with a consonant and their



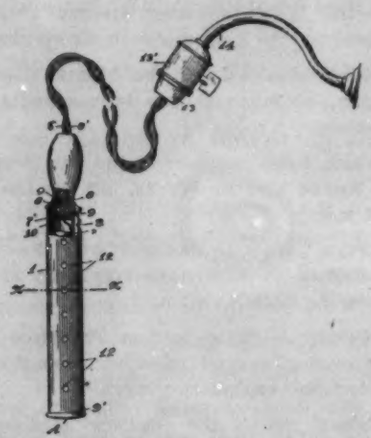
appropriate numbers, of sheets designated by vowels and showing series of two letter syllables beginning with a vowel and ending in a consonant, every syllable having appropriated thereto a series of numbers, whereby the contiguity of two consonants signifies the separation of two groups of numbers, the contiguity of a vowel and a consonant signifies their non-separation, and the contiguity of two vowels signifies a transfer to the sheets carrying said serial numbers.

986,064. Electric Battery. Carl Jaeger, Seattle, Wash. In a cell of a dry battery, in combination with the case, a closure for said case comprising a liquid holder of a destructible nature formed with an opening, a covering seal for said



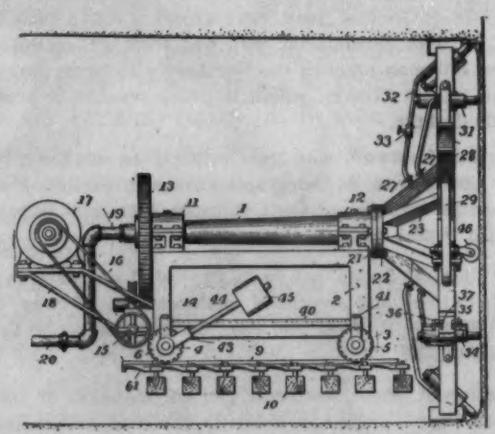
closure, a cork seated in the opening of said closure and projecting through the seal thereof, said cork being formed with a passage-way, a stopper in the passage-way of said cork, and a flexible puller attached to said stopper.

986,037. Electric Water-Heater. Abraham Albert, San Francisco, Cal., assignor, by mesne assignments, to Monarch Manufacturing and Supply Company. An electrical water heater, the same comprising an insulated handle provided with passage-ways for the current wires, an outer cylindrical perforated electrode secured thereto, an inner cylindrical perforated electrode fitted within the outer electrode and secured to said handle to leave an annular water circulating space between the electrodes, an insulated connection between the



lower ends of the said electrodes for holding the same spaced at such portion, current supply wires extended through the insulated handle and connected one to each electrode, and means for connecting the said wires to a source of electrical supply.

986,293. Tunneling and Shaft-Boring Machine. Franklin M. Iler, Denver, Colo. In a rock drilling machine, the combination with a suitable frame, of a hollow rotatable shaft carried by said frame, divergent rigid hollow arms constituting



a continuation of said hollow shaft and projecting therefrom at an angle, means for supporting fluid operated drills by said arms in various adjusted positions at different points, and means for connecting the inlet ports of said drills with the interior of said arms.

985,781. Process of Manufacturing Nitrate Fertilizers. Emil Collett and Moritz Eckardt, Christiania, Norway. The process of converting calcium cyanamid into nitrate of lime which consists in decomposing calcium cyanamid to produce ammonia, transforming the ammonia into nitrogen oxids or nitric acid, dissolving the residuum in the nitrogen oxids or nitric acid thereby obtaining a product containing nitrate of lime, all the nitrogen and all the lime contained in the original cyanamid.

NEWS NOTES

FINANCIAL.

CLAYTON, N. M.—Town of Clayton has voted $60,000 in bonds for a municipal water plant and system.

SAN DIEGO, CAL.—Sealed bids will be received up till March 27th for 340 water bonds valued at $1000 each.

BELLINGHAM, WASH.—Residents of Mountain View have subscribed $10,000 toward the construction of the proposed Nooksack interurban railway.

COLUMBUS, MONT.—It is understood that the electric railway line from Columbus to Cook City has been financed and that work will start when spring opens.

GRESHAM, ORE.—Bids will be received by D. Roberts, Recorder of Gresham, until the 4th of April for the whole or any part of $20,000 of the water bonds of the town of Gresham.

PASCO, WASH.—This place has rejected the proposition of the Pasco Reclamation Company to supply the city with irrigating water for the sum of $50,000. The majority of the people were in favor of the city purchasing its own plant.

CORVALLIS, WASH.—The Corvallis & Alsea River Railway, a logging line running from this place to Munroe, has been sold to the Portland, Eugene & Eastern Railway. The latter company announces that the newly purchased line will be electrified and extensions made.

GRESHAM, ORE.—Bids will be received by D. M. Roberts, Recorder of this place, up to April 4th for the purchase of $20,000 bonds. The sum of $15,000 of said bonds to be expended on the construction of a general water-works and system, and $5000 for the construction of a sewer and drainage system.

ORLAND, CAL.—To vote bonds for the sum of $50,000 for the installation of a municipal water and sewer system, the Board of City Trustees has called an election on May 2. One-half of the proposed bond issue will be devoted to the purpose of a water system and the balance of $25,000 to the construction of a sewer system.

WILLOWS, CAL.—The City Trustees at their last meeting decided to award the $40,000 bond issue, recently voted for the purpose of erecting a city hall, buying a hall site and purchasing fire apparatus, to E. H. Rollins & Co., of San Francisco, who offered $41,972. Other bidders and their bids were: J. H. Adams & Co., of San Francisco, $41,751; First National Bank of Willows, $41,512, and G. H. Baymyer of San Francisco, $40,870.50.

INCORPORATIONS.

LOS ANGELES, CAL.—Indian Hill Water Company of Pomona, $12,000, subscribed $125, by J. McKee, A. W. Richards, J. F. Cumberland, B. C. Strattan and S. Brubaker.

LOS ANGELES, CAL.—Rowland & Forster Water Company No. 1; capital stock, $25,000. Directors: W. R. Rowland, T. Del Valle, A. W. Ryan, T. W. Okey, George E. Cross.

SAN FRANCISCO, CAL.—Oro Electric Corporation, $10,000,000, shares $100 each, subscribed $700, by F. V. Pering, F. S. McAllister, W. B. Phelps, W. S. Wilsey, A. Harvey, E. Buchholz and W. G. Jack, 1 share each; place of business, San Francisco.

SAN BERNARDINO, CAL.—Articles of incorporation have been filed for the Jurupa Water Company. Capital stock is placed at $150,000. The incorporators are Arthur Wright, George H. Ennis, Frank H. Brooks, Marie Bohlander and Louis Boehler.

MARTINEZ, CAL.—Bay Point Light & Water Company, $25,000, shares $100 each, by Scott Hendricks, G. S. Arnold, Grant Smith, F. A. Warner and A. E. Fisks of San Francisco.

ILLUMINATION.

PASADENA, CAL.—An extension of the gas mains of the Los Angeles Gas & Electric Company will be made to Altadena.

YREKA, CAL.—Sealed bids are being received by the clerk of the Board of Supervisors for supplying electric light fixtures for the new hall of records.

SPOKANE. WASH.—Walter Bryant will develop the power at Boulder Falls, three miles below Orient, and put in an electric plant to supply lights for the town.

BAKER CITY, ORE.—The city engineer has been authorized to prepare plans and estimates for a pipe line from Ely Creek to Salmon Creek in the plan of a municipal electric lighting plant.

OLYMPIA, WASH.—Bids will be received by the State Board of Control until March 20 for an electrical generating set to be installed in Western Washington Hospital for the Insane at Fort Steilacoom, near Tacoma.

WILLOWS, CAL.—E. V. D. Johnson of Redding, manager of the Northern California Power Company, states that the contracts have been let for the construction of a new gas plant here, and that all work will be commenced by May 15.

WASHINGTON, D. C.—Many of the public land States are underlain with petroleum deposits; natural gas also is a frequent associate resource. The Geological Survey estimate reported two years ago to the National Conservation Commission of the oil contained in the California deposits alone places the figure as high as 8,500,000,000 barrels, although this is admittedly conservative. Careful geological examination has been made of the Western oil fields, and public oil land withdrawals now aggregate 3,796,572 acres in California, Oregon, Wyoming, Utah, New Mexico, Colorado and Louisiana. These withdrawls are made in aid of proposed legislation, the present gold-placer law under which oil or gas land must be acquired being absurdly inadequate and also providing no means for the Government to retain an oil supply for the Navy, in which every new ship is now equipped with oil-burning furnaces.

TRANSMISSION.

VALDEZ, ALASKA.—The management of the Alaska Water, Light & Telephone Company announces that a new transmission line and other improvements will be made to the plant this summer. The voltage will be increased from 2300 to 13,000.

JORDAN, CAL.—A snowslide destroyed the plant of the Hydroelectric Company at this place on March 7, killing 10 people and depriving a number of nearby mining camps of power. The power plant of the Crystal Mining Company near Bodie was also swept away in like manner.

BAKER CITY, ORE.—The matter of building a pipe line from Salmon Creek to Elk Creek has been taken up by the City Council and the city engineer has been ordered to prepare estimates of the cost of constructing a power house on the site, as well as the cost of an additional storage reservoir of 3,000,000 gallons capacity.

MILTON, ORE.—City Electrician Coyle is extending the city's power service into the fruit districts, the farmers using it for pumping purposes.

LE GRANDE, CAL.—Price & Parrott, San Joaquin Light & Power men have been in town making preliminary arrangements for the companys proposed power line between this place and Plainsburg.

SPOKANE, WASH.—Assurance that the Panhandle Electric Railway & Power Company will erect a $2,000,000 plant and transmission line to bring power from Priest River to Spokane, and that the company will enter into active competition with the Washington Water Power Company has been made by A. J. Smith, agent of the new company.

MILTON, ORE.—City Electrician L. E. Coyle will commence work setting poles and stringing wires for two new power lines into the country north and west of Milton. The first line to be built at once, will be located north and west of Sunnyside while another is soon to be built on the east side of the Walla Walla River.

WILLOWS, CAL.—The officers of the recently formed Peoples Power Company are C. R. Wickes, president; D. A. Shellcoe, vice president; W. H. Travis, secretary. The company will obtain its electricity through the Sacramento Valley Power Company and will erect supply stations at Orland and in this city. These two stations will represent an outlay of about $20,000.

TELEPHONE AND TELEGRAPH.

LEWISTON, MONT.—The Rocky Mountain Bell Telephone Company is spending $26,000 on improvements to its line into this city.

LONG BEACH, CAL.—Plans for the installation of a wireless telegraph plant on top of Hotel Virginia are under consideration by the management.

VALE, ORE.—The City Council has granted a franchise to R. S. Johnson and associates for the construction of an independent telephone system in this city. A company will soon be incorporated.

LOS ANGELES, CAL.—Fire supposed to have been caused by crossed wires broke out March 3 in the Home Telephone Exchange building, 246 South Hill street, put out of commission 15,000 phones in the business section of the city, and damaged the building and electrical equipment to the extent of $27,000. The loss is covered by insurance. Chief Engineer Leo Keller of the company says he believed the approximate loss on equipment and building will total $26,500.

TRANSPORTATION.

VALLEJO, CAL.—The Vallejo & Northern Railroad has obtained from the Board of Trustees the right to enter the city of Vallejo, the franchise granted being along the water front of the city.

SALINAS, CAL.—F. G. Baum, chief engineer of the Monterey County Gas & Electric Company, has made application for a franchise for an electric line from Monterey along the Salinas road to Castroville, via Salinas.

SAN FRANCISCO, CAL.—The Supervisors have passed a bill authorizing the Board of Public Works to expend any necessary sum up to $60,000 for the purchase of special track material for the Geary street municipal railroad.

VICTORIA, B. C.—Construction work will start at once on the suburban electric railroad from this place through the center of the Saanich peninsula to the northern terminus, for the British Columbia Electric Company. The line will be 22 miles in length.

FRESNO, CAL.—The deed to be given by the Fresno, Hanford and Summit Lake Railroad Company as security for the bonds which are being issued by the Guaranty Trust Company of New York has been signed. Work on the proposed interurban line will start at once, actual construction work starting near Lone Star.

SAN FRANCISCO, CAL.—The Board of Public Works has called for bids for the tubular steel poles and the redwood crossties for the municipal Geary road to be received March 22. No bids have been received for the latter on the board's first call, the ties being in great demand and the supply in sight for the market not equal to the requirements.

OAKLAND, CAL.—The Southern Pacific has submitted a plan which met with the favor of the City Council and an ordinance granting the railroad a franchise on Seventh street was passed to print by a unanimous vote. This ordinance provides for a 35-year term, a payment to the city of $5000 annually for the first 15 years and thereafter $8500 per annum; the paving of Seventh street at a cost of $200,000, and the lighting of the street at a cost of approximately $9000 per year.

WATERWORKS.

MOUNTAIN HOME, CAL.—An election will be held next week to vote on the question of issuing bonds for municipal water-works.

TRACY, CAL.—An application has been made by the Tracy Water-works Company for a franchise to lay pipes and operate a water system in this city.

BELLINGHAM, WASH.—The Keystone Meter Company presented the lowest bid for supplying the city with water meters, but the award has not yet been made.

ESCONDIDO, CAL.—A movement is on foot for the improvement of the city water system, the City Trustees having appointed a committee to report on the matter.

ASTORIA, ORE.—Bids will be received by the water commission up to March 31 for constructing a gate valve and laying 14,000 feet of iron pipe, 6, 8, 10, 12 and 18 inch, for the city. Check for 5 per cent of amount of bid required.

VALLEJO, CAL.—The City Clerk has been authorized to call for proposals for the laying of the 14-inch pipe line from Fleming Hill to Georgia street and 8-inch main from Georgia street to Fourth street, South Vallejo. Bids will be opened on April 3, 1911.

ASTORIA, ORE.—Palmberg & Matson have awarded a contract to the Wood Pipe Company of Portland for furnishing about 140 tons of steel bands to be used in the construction of the main conduit of the water system. They have also awarded a contract to Ness & Martin, of Portland, to furnish the connections and other castings required for the work.

BAKERSFIELD, CAL.—Fairbanks-Morse & Co. was awarded the contract for a 13 horsepower Jackson centrifugal pump for the High School Agricultural Farm for $675, The Western Gas Engine Company bid $670.10 for a 12 horsepower pump. The Pioneer Mercantile Company $922 for one of 15 horsepower and Ardizzi-Olcesse Company, $860, for one of 12 horsepower.

OCEANSIDE, CAL.—The United States Pipe Company of San Francisco has been awarded a contract for supplying pipe and fittings for extensions to be made to the city water system. Bids were for pipe, $34.15 per ton and for fittings, $62 per ton; total of contract $11,000. The City Clerk has been instructed to advertise for bids for digging ditches and laying mains.